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Excess Capacity and Adjustment Potential in U.S. Agriculture

By Leroy Quance and Luther Tweeten

Recursive aggregate demand and supply functions are used to simulate the ability of the farm sector to adjust during the 1970's to three policy alternatives. Different output demand elasticities and shifts in the supply and demand for farm output were assumed. Within reasonable bounds, agriculture could remain economically viable during the 1970's under policies diverting about 6 percent of potential output. An average of 6 percent was diverted from the market by Government production control, storage, and subsidized exports in 1962-69. Returning to a free market immediately or by 1980 would place severe financial strain on the farm sector.

Key words: Aggregate U.S. agriculture; excess capacity; Government programs; net farm income; simulation.

Ability of the farming industry to adjust to changing economic conditions depends on the magnitude of excess capacity, the characteristics of supply and demand, and the nature of public policies to deal with excess capacity. Excess capacity is defined in this paper as farm production in excess of market utilization at socially acceptable prices—current prices achieved by Government intervention. An operational definition of excess capacity is the value of production diverted from the market by Government production control, storage, and subsidized exports relative to potential farm output at current prices. One objective of this paper is to estimate excess capacity for recent years.

Excess capacity represents economic imbalance in resource use as well as output. The resource imbalance has been estimated elsewhere (*1*); measures of excess capacity in this paper focus on production.[1] The ability of the farm economy to cope with excess capacity, and the output, price, and income levels that would attend a more market-oriented farm industry, depend heavily on the characteristics of supply and demand. A second objective of this paper is to estimate output, prices, and net farm income from 1969 through 1980 under alternative assumptions about the elasticities of and shifts in demand and supply and under selected Government policies. These policies include continuing the programs of the 1960's, immediately eliminating Government programs, and gradually eliminating Government programs over the 1970's. The farm economy is simulated through 1980 to provide information on how it might adjust to different economic conditions and policies.

Footnotes are at end of article, p. 66.

Excess Productive Capacity

Given the supply and demand parameters and other characteristics of agriculture and its environment, our farm plant has the capacity to produce an aggregate output generally greater than that demanded at prices with a socially (politically) acceptable level and stability. In a free market, the burden of excess capacity would fall on the farmer in terms of uncertain and generally low product prices which complicate investment decisions and yield low returns, and on the consumer via erratic supplies and prices although average consumer prices would be somewhat lower. In a free market, excess capacity as defined herein would not exist. But society has chosen to modify the market mechanism by diverting from regular markets quantities in excess of that level which clears the market at socially acceptable prices.[2]

Tyner and Tweeten (*6*) estimated that excess productive capacity in 1955-61 ranged from a low of 5.3 percent in fiscal year 1957 to a high of 11.2 percent in 1959.[3] Tyner and Tweeten's procedure for measuring excess capacity is followed in this study. Annual excess production during 1962-69 is defined as the value of potential farm output diverted by Government land withdrawal programs plus the value of production diverted from commercial markets by Government storage operations (Commodity Credit Corporation) and subsidized exports (P.L. 480, etc.). The sum of the value of these diversions (at current prices) for major farm commodities is defined as aggregate excess production. And the ratio of this sum to the value of potential agricultural production is the relative excess capacity in each particular year (*6*, p. 23).

Table 1.—Estimated value of net additions to CCC stocks, seven major commodities, fiscal years 1963-69[a]

(In millions of dollars)

Year ending June 30	Wheat	Rice	Feed grains[b]	Cotton	Peanuts	Tobacco	Dairy products[c]	Total
1963.....	-26.2	8.3	-225.6	430.6	77.7	—	-10.7	254.1
1964.....	-347.5	-1.0	279.3	46.1	-77.7	—	-15.2	-116.0
1965.....	-246.4	-1.4	-361.9	328.6	—	—	-1.4	-282.5
1966.....	-498.8	-3.6	-409.4	278.7	—	—	-2.1	-635.2
1967.....	-301.3	-2.2	-380.9	-326.3	.7	—	15.8	-994.2
1968.....	-26.4	-.3	-8.0	-655.7	-.7	—	-5.6	-696.7
1969.....	74.9	29.0	188.6	-54.4	—	—	4.1	242.2

[a]Net changes in CCC inventories times seasonal average price.

[b]Sum of rye, corn, grain sorghum, barley, and oats.

[c]Milk equivalent of net USDA acquisitions times manufacturing milk prices.

Source: Quantities from Annual Reports of Financial Condition and Operations (Commodity Credit Corporation) and Dairy Situation (DS 327, Sept. 1969, Economic Research Service) were weighted by season average prices from Agricultural Statistics, various issues, except that dairy products (milk equivalent) were weighted by manufacturing milk prices.

Excess capacity is measured for the fiscal year (ending June 30) to conform with available data. Commodity Credit Corporation (CCC) and export data are by fiscal year. Quantities are weighted by average prices received by farmers during the crop marketing year. Program diversions and value of total farm output for year t, e.g., 1967, are used in calculations for "year" t-(t+1), e.g., 1967-68. To illustrate, the "analysis year" 1967-68 relates to net CCC stocks and subsidized exports for fiscal 1968, land diversions for 1967, marketing year prices for 1967-68, and value of total farm output for 1967.

CCC Storage Operations

The Commodity Credit Corporation acquires stocks through (a) acquisition of commodities pledged as collateral for price support loans, and (b) purchases of commodities from processors or handlers, or from producers by purchase agreements (*8*). CCC diversions shown in table 1 for seven major commodities are *net* additions to CCC stocks. These values were calculated as the quantities diverted times the seasonal average price received by farmers for the respective commodities.

A marked downward trend for CCC diversions in 1962-68 is apparent for all commodities except cotton. This trend reflects greater emphasis placed on supply control and heavy exports from CCC stocks under Government programs (P.L. 480, etc.) to relieve the pressure of large CCC stocks accumulated in earlier years and to aid food deficit areas of the world. In 1969, reduced exports resulted in a $242 million increase in CCC inventories.

Exports Under Aid Programs

Conceptually, at least two approaches can be used to estimate excess capacity diverted from commercial markets through export programs. One approach is to estimate the amount of commercial exports to aid recipients in the absence of aid programs. Andersen (*1*) estimated that, on the average, each ton of wheat (the major component of aid exports) under U.S. aid programs replaced 0.41 ton of commercial wheat imports from 1964 to 1966. This implies that the residual, 0.59 ton, should be imputed to excess capacity. Since the U.S. had substantial reserves of food, the major share of commercial exports replacing aid would have come from U.S. supplies. It appears that at least half of U.S. food aid exports could be charged to excess capacity based on rates of commercial export substitution.

The second approach is to measure the cash equivalent value of food aid. With cash, aid recipients could have purchased fertilizer plants, irrigation equipment, technical assistance to develop improved crop varieties, or other items. In the 3-year period 1964-66, the cash equivalent value of food aid was 48.1 percent of the reported market value of food aid exports, excluding transportation costs (*1*). Thus approximately half of the value of food aid is imputed to real foreign aid (foreign economic development); the other half to support of domestic farm prices (excess capacity).

We assume that half of exports under Government programs are charged to excess capacity in table 2 for seven major commodity groups for the years 1962-68. These diversions fluctuated around $700 million from 1962 to 1968 with wheat accounting for over half of the diversions. In 1969, exports under aid programs

Table 2.—Estimated value of excess capacity exported under Government programs, seven major commodities, fiscal years 1963-69

(In millions of dollars)

Year ending June 30	Wheat	Rice	Feed grains[a]	Cotton	Peanuts	Tobacco	Dairy products	Total
1963.....	421.0	42.7	54.8	81.0	—	18.4	48.0	665.9
1964.....	434.4	43.5	41.5	71.0	—	18.0	69.5	677.9
1965.....	495.4	34.4	38.1	82.5	—	17.7	51.2	719.3
1966.....	468.6	30.0	56.8	61.8	—	45.0	45.4	707.6
1967.....	322.8	65.6	103.5	82.5	—	53.4	51.0	678.8
1968.....	383.6	68.5	59.5	87.4	—	52.6	55.0	706.6
1969.....	199.0	80.8	18.5	45.0	—	14.4	71.2	428.9

[a]Includes corn, grain sorghum, barley, oats, and rye.

Sources: Econ. Res. Serv., 12 Years of Achievement Under Public Law 480, ERS-Foreign 202, Nov. 1967, and Foreign Agricultural Trade of the United States, 1968, p. 22; and (*8*).

decreased $278 million, more than offsetting the $242 million net additions to CCC stocks.

Land Withdrawal Programs

Net additions to CCC stocks and subsidized exports remove excess output already produced. Growing emphasis during the 1960's was placed on removing land from production to control output before it was produced. Estimates of land diverted from various crops are made from USDA data (*2*, *7*). A crucial question is "How productive is the diverted land?" Many persons agree that farmers divert marginal cropland and that, on the average, diverted land is less productive than land in production. Ruttan and Sanders estimated that productivity of diverted land may be as little as one-third that of land in production (*3*). But others (*12*) estimate that diverted acres may be 90 percent as productive as cropland in production. To estimate the potential farm output diverted by land withdrawal programs, we arbitrarily assume that yields on diverted acres would be 80 percent of average crop yields for each respective crop and year. Estimates of the potential production of three major crops were weighted by average prices received by farmers to obtain the value of potential farm output diverted by Government land withdrawal programs (table 3). The three crop categories in table 3 accounted for the normal use of 63 percent of the cropland in the Conservation Reserve in 1960 (*2*, p. 47), and the proportion these three crops comprise of total diversions by specific commodity programs would be even greater.

Feed grains account for about three-fourths of the potential production on diverted acres which, according to our estimates, was highest ($3.2 billion) in 1966 and lowest ($1.9 billion) in 1967, and was $2.7 billion in 1968. Diversions by land withdrawal programs generally increased except in 1963 when acres diverted from corn production decreased 3.3 million acres, in 1964 when the value of wheat acreage diversions declined by almost two-thirds, and in 1967 when concern over our dwindling surpluses and the world food deficit caused a reduction of production controls.

Aggregate Excess Capacity

Estimates in tables 1 to 3 of net additions to CCC stocks, Government-aided exports, and potential production on diverted acres are summarized and added

Table 3.—Estimated value of diversions by land withdrawal programs, three major crops, crop years 1962-68

(In millions of dollars)

Crop	1962	1963	1964	1965	1966	1967	1968
Wheat . . .	552.4	550.7	198.2	250.1	334.7	34.7	279.2
Feed grains	1,845.2	1,651.3	1,924.0	2,325.9	2,493.8	1,429.8	2,137.3
Cotton . .	60.2	64.8	104.4	151.8	389.4	468.7	290.3
Total . .	2,457.8	2,266.8	2,226.6	2,727.8	3,217.9	1,933.2	2,706.8

Sources: Acres removed by the conservation reserve and various commodity programs are from Agricultural Statistics, various issues. Estimates of normal use of land in the conservation reserve were taken from Economic Effects of Acreage Control Programs in the 1950's (*2*). Assumed production on diverted acres was weighted by the average prices received by farmers.

Table 4.—Government diversions, farm output, and excess capacity in agriculture, fiscal years 1963-69

Year ending June 30	Government diversions				Farm output[a]	Excess capacity[b]
	CCC	Land withdrawals	Subsidized exports	Total		
	Mil. dol.	*Mil. dol.*	*Mil. dol.*	*Mil. dol.*	*Mil. dol.*	*Percent*
1963.....	254.1	2,457.8	665.9	3,377.8	38,806.6	8.19
1964.....	-116.0	2,266.8	677.9	2,828.7	40,391.9	6.63
1965.....	-282.5	2,226.6	719.3	2,663.4	41,111.9	6.15
1966.....	-635.2	2,727.8	707.6	2,800.2	40,522.7	6.48
1967.....	-994.2	3,217.9	678.8	2,902.5	37,096.4	7.20
1968.....	-696.7	1,933.2	706.6	1,943.1	40,904.3	4.54
1969.....	242.2	2,706.8	428.9	3,377.9	40,308.0	7.85

[a]Net farm output in 1957-59 dollars adjusted to current values by the index of prices received by farmers (1957-59 = 100). Farm output estimates are from worksheets of the Farm Adjustment Branch, Farm Production Economics Division, ERS.

[b]Government diversions as a percentage of potential farm output where diversions of land withdrawal programs are added to actual farm output to more adequately reflect "total capacity" of agriculture.

to show aggregate excess production in table 4. Total diversions are then expressed as a percentage of potential farm output for fiscal 1963 to 1969 as a measure of excess capacity. These estimates are probably the lower bound on real excess capacity. There is some excess capacity in commodities not included in our estimates. If government programs were eliminated, farmers could bring more "new lands" into production as well as most of the diverted acres accounted for in this study.

Our estimates indicate that the adjustment gap in U.S. agriculture in the 1960's ranged from 6.2 to 8.2 percent, except for 1968, when our dwindling carryover and the world food gap led to a large decrease in diverted acres. In the 1960's, CCC stocks declined in every year except 1963 and 1969. Net declines in CCC stocks in recent years just about offset subsidized exports, and excess capacity is approximately equal to what could have been produced on land in Government land withdrawal programs. In simulating possible future adjustments in the farm economy, we use 6 percent of potential agricultural output as a measure of current excess capacity.

Supply Parameters

Supply elasticities indicate the speed and magnitude of output adjustments in response to changes in product price. The price elasticity for aggregate farm output is especially important because it measures ability of the farming industry to adjust production to changing economic conditions continually confronting it in a dynamic economy.

Farmers have considerable latitude to substitute one commodity for another in production over a long period. Eventually, this should lead to adjustments among commodities until comparable resources are earning similar rates of return in production of each commodity. And because farm resources are adjusted much more easily among farm commodities than between farm and nonfarm commodities, it follows that the aggregate supply response, which tends to determine total resource earnings in agriculture, is less than the supply response for individual commodities (*5*, p. 342).

Point estimates of the aggregate supply elasticity were computed by the authors using three approaches: (a) Direct least squares, (b) separate yield and production unit components for crops and livestock, and (c) separate input contributions (*5*).[4] From these approaches we conclude that the supply elasticity is 0.10 in the short run and 0.80 in the long run for decreasing prices. But for increasing prices, the supply elasticity is considered 0.15 in the short run and 1.5 in the long run.

Shift in supply due to nonprice variables.—The best available indicator of the shift in the aggregate supply function for farm output is USDA's productivity index (*10*). With a rather stable input level from 1940 to 1960 and rising output, productivity per unit of input increased about 2 percent per year from 1940 to 1960. But the productivity index was only 2.9 percent higher in 1968 than in 1960—the annual 1960-68 increase was only 0.35 percent. The slowing of the increase is caused in part by the fact that the 1947-49 weights used in constructing the index were inappropriate for the 1960's. In our analysis, partly to compensate for a lack of confidence in past estimates of shift in aggregate supply over time and partly to simulate different levels of technological change in the future, we alternatively assume a 0.0, 1.0, and 1.5 percent increase per year in quantity supplied, due to technology and other supply shifters.

Demand Parameters

Many forces influence the demand for farm output. Some forces are social and some are political, but many are economic factors that grow out of the market system as it reflects increased population and the changes in consumption in response to prices and income. We divide these economic forces into the price elasticity of demand and the annual shift in demand.

Price elasticity of demand.—The demand for U.S. farm output consists of a domestic component (including inventory demand) and a foreign component. Because of the uncertain magnitude of the elasticity of foreign demand for U.S. food, feed, and fiber, there is considerable difference of opinion as to the exact magnitude of the elasticity of total demand. Tweeten's findings indicate the price elasticity of total demand is about −0.3 in the short run and −1.0 in the long run (*4*). But some economists believe these estimates are too high. In our analysis, we use demand elasticities of −0.3 in the short run and −0.5 in the long run to more nearly conform to conventional wisdom. Use of these elasticities also gives us a chance to view the reasonableness of the alternative estimates in the context of the simulated farm economy.

Shift in demand due to nonprice variables.—It is easier to predict shifts in the demand for farm products in the domestic market than in the foreign market. The annual increment in domestic demand is divided into a population effect and an income effect. In the decade preceding 1968, population grew at an annual compound rate of 1.24 percent. Personal consumption expenditures in constant dollars grew 2.6 percent per capita in the same period. If these trends continue, then based on a 0.15 income elasticity of demand at the farm level, the domestic demand for farm output will grow by 1.24 plus 2.6 (0.15) or a total of 1.63 percent per year.

On the export side, Tweeten projected a 4 percent annual increase in demand for U.S. farm exports to 1980. If 17 percent of farm output is exported, then total demand for farm output is projected to increase 0.83(1.6) = 1.3 percent from domestic sources and 0.17(4) = 0.7 percent from foreign sources, or a total of 2.0 percent per year.

This demand projection may be too optimistic in light of recent developments. If annual export demand grows 3 percent, per capita domestic income 2 percent, and population 1 percent, and if the domestic income elasticity of demand is 0.10, then demand for farm output will grow only 1.5 percent annually. In our analysis, we use shifts in demand of 1.0, 1.5, and 2.0 percent per year.

Adjustment Potential in the 1970's

The adjustment potential of the farm economy is simulated from 1969 to 1980 under three different assumptions with regard to Government diversion programs. The first is that the Government continues to divert 6 percent of potential agricultural output from conventional market channels. Government payments to farmers are assumed to continue at the 1969 level, although, in reality, the level of Government payments would likely be positively correlated to diversions. The second alternative assumes a gradual elimination of diversions and Government payments by 1980. The third alternative is to terminate all diversions and Government payments at the beginning of 1970—an immediate free market. To account for uncertain trends in the supply and demand for farm output and to determine the impact of different assumptions about the elasticity of demand, each policy alternative is simulated over six different combinations of supply and demand parameters. These six different combinations range from the most to the least favorable conditions likely to prevail for agriculture in the 1970's.

The Model

The simulation model is built around a simple recursive formulation of the aggregate supply equation (1) and demand equation (2):

$$(1) \quad Q_t = \alpha_s \left(\frac{P}{P_d}\right)_{t-1}^{\beta_s} Q_{t-1}^{(1-\delta_s)} \, 2.718^{g_s(1-\delta_s+\delta_s T)}$$

$$(2) \quad P_t = \left[Q_t / (\alpha_d Q_{t-1}^{(1-\delta_d)} \, 2.718^{g_d(1-\delta_d+\delta_d T)})\right]^{1/\beta_d}$$

The quantity supplied in year t, Q_t is dependent upon the real price in year t-1.[5] This supply equation is basically a free market supply function in that the quantity supplied includes diversions as well as the quantity moving into regular market channels.

The supply quantity, predetermined by past prices and adjusted as necessary for exogenously determined Government program diversions, is then fed into the demand equation to determine price in year t. Demand quantities are equal to supply quantities minus Government diversion. Gross farm receipts in year t are equal to the market clearing demand quantity multiplied by the price in year t. Adding Government payments to gross farm receipts yields gross farm income. Real production expenses, assumed to equal 77.43 percent of the real quantity marketed in year t (a percentage based

Table 5.—Estimates of prices received by farmers, parity ratio, quantity supplied, quantity demanded, and gross and net farm income under alternative Government policies, and with various combinations of demand and supply parameters, 1969 and 1980

Policy alternative and specified variable[a]	Actual values in 1969	Simulated 1980 values when elasticity of demand is–					
		–0.3 (short run) and –1.0 (long run), with annual percent shift in demand/supply			–0.15 (short run) and –0.5 (long run), with annual percent shift in demand/supply		
		2.0/1.0	1.5/1.0	1.5/1.5	2.0/1.0	1.5/1.0	1.5/1.5
Continuation of present programs (6 percent diversion):							
Index of prices received by farmers	275.0	325.6	313.8	305.9	352.8	335.1	322.6
Parity ratio	73.7	70.2	67.7	66.0	76.1	72.3	69.6
Quantity supplied	54,182	56,227	55,458	56,570	58,139	56,869	57,743
Quantity demanded	50,804	52,854	52,130	53,178	54,651	53,457	54,278
Gross farm income	54,598	66,376	63,282	62,949	73,899	68,937	67,458
Net farm income	16,534	17,130	14,719	13,412	22,988	19,138	16,894
Gradual elimination of Government diversions and a free market by 1980:							
Index of prices received by farmers	275.0	310.1	298.9	291.4	329.3	311.9	300.3
Parity ratio	73.7	66.9	64.4	62.8	71.1	67.3	64.7
Quantity supplied	54,182	55,076	54,322	55,392	56,160	55,139	55,966
Quantity demanded	50,804	55,076	54,322	55,392	56,160	55,139	55,966
Gross farm income	54,598	62,105	59,043	58,703	67,256	62,544	61,109
Net farm income	16,534	10,799	8,439	7,101	14,940	11,178	8,973
Free market effective in 1970:							
Index of prices received by farmers	275.0	314.6	303.3	295.4	335.9	322.5	313.5
Parity ratio	73.7	67.8	65.4	63.7	72.4	69.5	67.6
Quantity supplied	54,182	54,684	53,912	55,121	55,936	54,525	55,152
Quantity demanded	50,804	54,684	53,912	55,121	55,936	54,525	55,152
Gross farm income	54,598	62,562	59,464	59,200	68,332	63,942	62,870
Net farm income	16,534	11,619	9,241	7,851	16,223	13,148	11,492

[a]The index of prices received by farmers for all farm commodities and the parity ratio are based on 1910-14 = 100. All quantity figures are in millions of 1969 dollars, and income figures are in millions of current dollars. A 2.0 percent rate of input price inflation is assumed.

[b]The elasticity of supply is 0.1 in the short run and 0.8 in the long run when the parity ratio is decreasing, but 0.15 in the short run and 1.5 in the long run when the parity ratio is increasing.

on 1969 data in the Farm Income Situation (*11*), are inflated 2 percent per year to reflect rising input prices and subtracted from gross farm income to yield net farm income in year t.[6] Both marketings and production expenses are net of interfarm sales.[7]

Results

The shift in the supply function due to technological advance was near zero from 1963 to 1970. Assuming a 2.0 percent shift in demand and a stable supply function, farm prices by 1980 could be from 18.6 to 30.1 percent higher than in 1969, and net farm income could increase from $16.5 billion in 1969 to as high as $23.6 billion, depending on the assumed diversion policy and on the choice of demand elasticities. Such highly favorable conditions for agriculture are unlikely in the 1970's and results of these conditions are not tabulated. Alternative estimates, summarized in table 5, indicate that depending on the true magnitude of the elasticity of demand and the shifts in supply and demand, conditions less favorable than those above are likely to exist in 1980. Only beginning and ending year data are given in table 5.

Equal shift in demand and supply.—The farm sector can maintain its viability through 1980 according to estimates in table 5. But the importance of Government diversion programs is evident. Under unfavorable conditions for agriculture—an equal 1.5 percent annual shift in demand and supply, -0.30 and -1.0 elasticities of demand in the short run and long run respectively, and gradual elimination of Government diversion—the parity ratio would fall from 73.7 in 1969 to 62.8 in 1980 and net farm income would decrease approximately 57 percent, from $16.5 billion in 1969 to $7.1 billion in

1980. And our estimates indicate that an immediate reversion to free markets in 1970 would cause havoc in the first year—a decrease of 15 points in the parity ratio and a drastic decline in net farm income. Despite the relatively more favorable long-run outcome of a "one-shot" as opposed to a gradual return to a free market by 1980, the severe short-run impact of the one-shot return seems to rule it out as an acceptable policy alternative.

Demand increasing twice as fast as supply.—If the annual shift in demand for U.S. farm output is double that in supply, as illustrated by the 2.0 percent shift in demand and 1.0 percent shift in supply in table 5, the farm sector would gain by 1980 with continuation of Government programs similar to those of the 1960's. If the short-run demand elasticity is -0.15, prices received by farmers in 1980 would be 119.7 percent of 1969 prices under a policy of gradually eliminating Government diversions and payments. But 2 percent annual input-price inflation causes the parity ratio to decline from 73.7 to 71.1. Net farm income would decrease moderately to $14.9 billion. Under the "immediate free market" alternative, a 72.4 parity ratio and $16.2 billion net farm income result. But if present diversion and payment policies were continued, farm prices would reach 128.3 percent of the 1969 level and net farm income would be $23.0 billion—the highest of any alternative reported in table 5.

Using the higher (absolute value) demand elasticities results in less favorable but viable conditions for agriculture in 1980 if diversion policies are continued. With a continuation of programs to divert 6 percent of potential farm output from commercial markets, net farm income would increase $0.6 billion over the 1969 level.

Demand increasing 50 percent faster than supply with high demand schedule.—The set of outcomes in table 5 which most nearly fits our expectations for 1980 results from a 1.5 percent annual shift in demand, a 1.0 percent annual shift in supply, a -0.3 short-run demand elasticity, and a -1.0 long-run demand elasticity.[8] Depending on Government diversion and payment policies, the parity ratio would decrease 6 to 9 points. With one exception, the quantity of farm products demanded and supplied would increase. Net farm income would decrease moderately to $14.7 billion under continuation of diversion and Government payment policies of the 1960's, and it would decrease severely to $9.2 billion under a 1970 free market supply and to $8.4 billion under a policy that gradually reverts to a free market by 1980. Thus continued diversion and payment programs are needed to avoid a major drop in net farm income. Table 6 contains annual estimates for this set of outcomes.

Estimates in table 6 further illustrate the serious adjustment problems which would likely exist under a one-shot compared with a gradual policy to eliminate Government diversions and payments. Net farm income is higher by 1980 with the one-shot free market policy, but gradual elimination of diversions to achieve a free market by 1980 appears to offer major advantages during the difficult transition period.

If the program of the 1960's is continued, our estimates indicate that prices received by farmers will increase about 1.2 percent per year and will reach 114.1 percent of 1969 prices by 1980. But continued input-price inflation at the assumed rate of 2 percent per year would deflate this nominal price gain to a loss of 6 points in the parity ratio. Quantity supplied would increase $1.3 billion, to reach $55.5 billion by 1980, compared with a quantity demanded of $52.1 billion. Government diversions would decrease $50.3 million, reaching $3.33 billion in 1980. Gross farm receipts would increase 17 percent to $59.5 billion by 1980. According to our assumption, real production expenses rise in proportion to the quantity marketed (no production costs on diverted production), and are then inflated at the annual rate of 2 percent. These expenses would reach $48.6 billion by 1980. With production expenses rising faster than gross farm income, net farm income decreases 1.0 percent per year to $14.7 billion by 1980.

Estimates in table 6 also illustrate some weakness in the model. The deterministic simulation model used to generate the estimates is free of the random and often severe fluctuations which occur in agricultural production and export demand due to weather and other uncontrollable factors. Recent increases in prices paid by farmers exceed the annual 2.0 percent rate assumed in this paper. This aspect of adjustments in the farm economy needs additional research, and some recent estimates by the authors indicate that adjustments in the farm economy may be significantly affected by a higher rate of input-price inflation. Also, the kinds of aggregate adjustment patterns derived above need to be related to classes and types of farms by region. For example, it would be useful to know the impact of a 50 percent drop in net farm income on the viability of the commercial farm unit in 1980 in the different commodity sectors. Attention to these issues will increase the effectiveness of our model in analyzing public policies for dealing with excess capacity in agriculture and the ability of agriculture to adjust.

Summary

Excess capacity in U.S. agriculture in recent years has averaged about 6 percent of potential output. In the

Table 6.–Estimated adjustment patterns of selected variables in the agricultural sector, 1969-80[a]

Year	Index of prices received	Index of prices paid	Parity ratio	Quantity supplied	Quantity demanded	Government diversions	Gross farm receipts	Gross farm income	Production expenses	Net farm income
	1910-14 = 100			*Million 1969 dollars*			*Million current dollars*			
Continuation of present program (6 percen diversion):										
1969	275.00	373.00	73.73	54,181.72	50,803.92	3,377.80	50,803.92	54,597.92	38,063.82	16,534.10
1970	276.04	380.46	72.55	54,229.38	50,975.61	3,253.76	51,167.20	54,961.20	38,956.25	16,004.95
1971	282.03	388.07	72.68	54,251.86	50,996.75	3,255.11	52,300.15	56,094.15	39,751.85	16,342.30
1972	286.42	395.83	72.36	54,260.51	51,004.88	3,255.63	53,122.07	56,916.07	40,553.32	16,362.74
1973	288.37	403.75	71.42	54,400.35	51,136.32	3,264.02	53,622.00	57,416.00	41,470.99	15,945.00
1974	292.34	411.82	70.99	54,520.25	51,249.03	3,271.21	54,479.56	58,273.56	42,393.60	15,879.96
1975	295.75	420.06	70.41	54,660.13	51,380.52	3,279.61	55,256.34	59,050.34	43,352.41	15,697.93
1976	299.34	428.46	69.86	54,806.36	51,517.97	3,288.38	56,077.02	59,871.02	44,337.74	15,533.28
1977	302.91	437.03	69.31	54,960.79	51,663.14	3,297.65	56,905.64	60,699.64	45,351.91	15,347.73
1978	306.52	445.77	68.76	55,121.36	51,814.07	3,307.28	57,751.53	61,545.53	46,394.04	15,151.49
1979	310.15	454.68	68.21	55,287.30	51,970.07	3,317.24	58,612.09	62,406.09	47,464.40	14,941.69
1980	313.82	463.78	67.67	55,457.80	52,130.33	3,327.47	59,487.60	63,281.60	48,562.95	14,718.66
Gradual elimination of diversions, free market by 1980:										
1969	275.00	373.00	73.73	54,181.72	50,803.92	3,377.80	50,803.92	54,597.92	38,063.82	16,534.10
1970	270.76	380.46	71.17	54,229.38	51,271.41	2,957.97	50,481.04	53,930.13	39,182.30	14,747.83
1971	276.85	388.07	71.34	54,147.34	51,489.19	2,658.14	51,835.62	54,939.80	40,135.71	14,804.09
1972	280.73	395.83	70.92	54,016.05	51,658.98	2,357.06	52,735.19	55,494.46	41,073.39	14,421.07
1973	280.72	403.75	69.53	54,077.29	52,012.52	2,064.77	53,093.27	55,507.63	42,181.57	13,326.06
1974	283.88	411.82	68.93	54,091.18	52,320.92	1,770.26	54,009.93	56,079.39	43,280.27	12,799.11
1975	286.16	420.06	68.12	54,124.43	52,648.30	1,476.12	54,784.41	56,508.95	44,422.10	12,086.85
1976	288.72	428.46	67.39	54,157.30	52,975.68	1,181.61	55,617.45	56,997.09	45,592.29	11,404.80
1977	291.22	437.03	66.64	54,194.66	53,307.84	886.82	56,451.12	57,485.84	46,795.68	10,690.16
1978	293.76	445.77	65.90	54,234.56	53,642.91	591.65	57,301.97	57,991.79	48,031.57	9,960.21
1979	296.32	454.68	65.17	54,277.03	53,980.97	296.06	58,165.70	58,510.61	49,300.96	9,209.64
1980	298.91	463.78	64.45	54,321.72	54,321.72	0.00	59,043.35	59,043.35	50,604.38	8,438.97
Free market effective in 1970:										
1969	275.00	373.00	73.73	54,181.72	50,803.92	3,377.80	50,803.92	54,597.92	38,063.82	16,534.10
1970	224.59	380.46	59.03	54,229.38	54,229.38	0.00	44,288.39	44,288.39	41,442.82	2,845.57
1971	283.98	388.07	73.18	53,144.38	53,144.38	0.00	54,878.63	54,878.63	41,425.92	13,452.70
1972	272.02	395.83	68.72	53,317.55	53,317.55	0.00	52,739.98	52,739.98	42,392.11	10,347.88
1973	278.60	403.75	69.00	53,296.70	53,296.70	0.00	53,994.26	53,994.26	43,223.03	10,771.23
1974	286.19	411.82	69.49	53,092.41	53,092.41	0.00	55,253.02	55,253.02	43,918.46	11,334.56
1975	289.27	420.06	68.86	53,018.47	53,018.47	0.00	55,768.70	55,768.70	44,734.43	11,034.27
1976	288.55	428.46	67.35	53,245.26	53,245.26	0.00	55,868.54	55,868.54	45,824.29	10,044.24
1977	293.14	437.03	67.08	53,392.19	53,392.19	0.00	56,913.37	56,913.37	46,869.73	10,043.64
1978	296.25	445.77	66.46	53,566.43	53,566.43	0.00	57,705.58	57,705.58	47,963.09	9,742.49
1979	299.83	454.68	65.94	53,736.87	53,736.87	0.00	58,588.77	58,588.77	49,078.02	9,510.75
1980	303.32	463.78	65.40	53,911.88	53,911.88	0.00	59,463.75	59,463.75	50,222.58	9,241.17

[a]These estimates resulted from a −0.3 short-run and −0.1 long-run demand elasticity; a 0.1 short-run and 0.3 long-run supply elasticity for a decreasing parity ratio and a 0.15 short-run and 1.5 long-run elasticity for an increasing parity ratio; a 1.5 percent annual increase in demand and 1.0 annual increase in supply; and 2 percent annual input price inflation.

1960's, CCC stocks declined in every year except fiscal 1963 and 1969, and that part of exports attributed to excess capacity remained at approximately $700 million until decreasing to $429 million in 1969. Net declines in CCC stocks in recent years just about offset subsidized exports. Thus excess production, $3,378 million in 1969, is approximately equal to what would have been produced on land in Government land withdrawal programs.

We conclude, based on previous studies and on results of the simulation model used in this study, that the best available estimates of supply and demand parameters are: Supply elasticities, 0.10 in the short run and 0.80 in the long run for decreasing prices, and 0.15 in the short run and 1.5 in the long run for increasing prices; demand elasticities, of −0.3 in the short run and −1.0 in the long run; and annual average shifts in the supply and demand functions due to nonprice variables, 1.0 and 1.5 percent, respectively.

Within reasonable bounds of the above parameters, agriculture has the ability to remain economically viable during the 1970's under policies to divert from commercial markets about 6 percent of potential farm output coupled with direct payments of up to $4 billion annually. With prices paid increasing more rapidly than prices received, the quantity supplied tends to be restricted and thus net farm income decreases less through 1980 if the price elasticity of demand for farm products is under −0.3 in the short run and −1.0 in the long run. Returning to a free market immediately or gradually by 1980 would place severe financial strain and adjustment pressure on the farm sector. A one-shot return to a free market, if it had occurred in 1970, would find a less depressed agriculture by 1980 than would a gradual return to a free market. But the severe short-run impact of the one-shot return seems to rule it out as an acceptable policy alternative.

Given the supply and demand parameters specified above and a continued policy to divert about 6 percent of potential production, the parity ratio would fall 6 points by 1980 and net farm income would decrease to $14.7 billion, compared with $16.5 billion in 1969. A gradual return to a free market would result in a 4.8 percent reduction in the parity ratio relative to 1969 and net farm income would decrease about 50 percent to $8.4 billion in 1980. Net farm income would be $6.3 billion less by 1980 under a gradual return to a free market than under a continuation of the present program.

It is beyond the scope of this paper to analyze adjustments by commodity groups and regions. The aggregate analysis reported herein provides useful insights only into the economic viability of the farming industry. While analysis of commodity sectors and regions would be desirable, opportunities for substitution permit at least short-run disparities in the economic health of one sector or another without any real insight into the economic health of the aggregate as reported in this paper.

Knowledge of the overall economic health of the farm industry is vital for policy planning. Two general approaches may be used to gain needed information. One is the aggregative approach used in this paper. A second is a disaggregate approach, building aggregate estimates up from studies of component crop and livestock sectors. Inability to quantify substantial opportunities for substitution among commodities in production and consumption preclude realistic aggregate results from micro studies. On the other hand, it may be feasible to anchor microeconomic projections in the aggregative projections of this study. An analysis of adjustments over time by commodity group, region, and farm class would clearly be desirable and a logical extension of the aggregate estimates contained in this study.

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Footnotes

[1]Italic numbers in parentheses indicate items in the References.

[2]Socially acceptable prices here refer to prices farmers receive for farm-produced commodities. They are generally market or Government support prices but also could be defined to include Government direct payments to farmers.

[3]This definition of, and technique for measuring, excess capacity does have some shortcomings. First, data on some diversions of the kind included in this definition are unavailable or insufficient to include in our estimates. Second, farmers' inability to organize production at the optimal level and least-cost combination of production inputs is another kind of excess capacity. Tyner and Tweeten (*7*) estimate that this latter type of excess capacity is approximately equal in dollar value to excess output. But excess capacity due to less than optimal resource combination is internal to agriculture and would be present, perhaps even to a greater extent, in the absence of Government programs. Thus excess capacity, as estimated in this study, is an adequate and operational measure of the farm sector's ability to adjust to changing economic conditions with and without Government programs.

[4]The aggregate supply elasticity reflects adjustments of livestock and crops to changes in prices received by farmers. The slow adjustment for livestock largely explains the greater magnitude of the elasticity in the long run than the short run. An alternative approach to that used in this study would be to estimate crop and livestock excess capacity separately and apply respective elasticities. To determine aggregate effects, cross elasticities could be used to bring the sectors together. We rejected this approach because cross elasticities have never been estimated with acceptable reliability, and we have more confidence in estimates of the aggregate elasticities than in individual crop and livestock components.

[5]The supply and demand functions are linear in logarithms. For the supply function, (1), Q_t is the quantity supplied in year t. a_s is the supply constant. $(P/P_d)_{t-1}$ is the price P received by farmers, deflated by the price P_d paid by famers for production inputs in year t-1. β_s is the short-run supply elasticity. The coefficient $(1-\delta_s)$ of the quantity supplied in year t-1 specifies an adjustment rate δ_s, where the long-run supply elasticity is equal to β_s/δ_s. The exponent $g_s(1-\delta_s+\delta_s T)$ for the base of the natural logarithm (2.718) is required to maintain a constant shift in supply over the short- and long-run adjustments to time, T. Coefficient g_s is the annual percentage increase in the quantity supplied due to nonprice variables.

The demand function, transposed in (2) to make P the dependent variable, is specified similarly to the supply function with corresponding parameters subscripted with a d to denote demand.

[6]Using data from the Farm Income Situation, marketings net of interfarm sales are deflated by the index of prices received by farmers and production expenses net of interfarm sales are deflated by the index of prices by farmers. The resulting ratio of real production expenses to real marketings actually decreased from 0.67 in 1951 to 0.57 in 1969. Thus, the historical increase in production expenses was due to output expansion and input-price inflation, and not to increases in real purchased inputs relative to real marketings.

[7]Interfarm sales are assumed to equal 25 percent of purchased seed plus 50 percent of purchased feed plus 75 percent of purchased livestock. In 1969, interfarm sales amounted to $6,621 million, realized gross farm income excluding Government payments totaled $50,804 million, Government payments were $3,794 million, and production expenses were $38,064 million. Net farm income, equal to gross farm income including Government payments minus production expenses, was $16,534 million (*11*, p. 44).

[8]The results apply more generally to a situation in which the shift to the right in demand exceeds that of supply by 0.5 percentage point annually. The demand and supply parameters specified above were the most reasonable choices, based on results from previous studies in which a wide range of estimates were considered. Also, these parameters provide the most reasonable set of outcomes in results of the simulation model reported herein.

Areal Delineations for Rural Economic Development Research

By Clark Edwards and Robert Coltrane

A number of possible geographic delineations can be used for areal allocation of population, income, employment, and other social and economic characteristics, in a rural development indicator system. This paper shows that estimates of statistical parameters vary for alternative geographic aggregations and for alternative delineations at a given level of aggregation, and that estimates of statistical parameters for alternative delineations vary as the level of structural disaggregation of variables used in the analysis is varied. Nine delineations and 12 characteristics were used to examine the statistical consequences of alternative delineations.

Key words: Areal delineation; rural economic indicators.

The geographic location of economic activity may be as important a variable in an analysis of rural economic development problems as price and quantity. Thus, economic indicators and situation statements for rural development purposes need to account for location in geographic as well as economic space.

One way to locate activity in space is to pinpoint the latitude and longitude at which it occurs. Another is to reference the general geographic area in which the activity occurs, such as by city, county, or State. Such areas are treated as if they were points for the purposes of economic analysis. Analyses using the areal system of location presuppose a delineation of geographic space into suitable areas.

There are numerous ways to delineate geographic space into areal units. However, statistical results describing economic and social characteristics differ according to the way units are delineated. The United States is divided into over 3,000 counties. Means, variances, correlation coefficients, and related statistical parameters for specific variables computed for counties, and for successive levels of aggregation of the counties into multicounty areas, State areas, and multi-State areas, can be expected to vary. This holds both for alternative levels of geographic aggregation and for alternative delineations at a given level of geographic aggregation.

In addition to geographic aggregation, another consideration is structural aggregation. An example of structural aggregation would be measuring total population as opposed to distribution of population by age, sex, and race. The areal delineation becomes critical when the analyses require structural disaggregation of variables. Consequently, the results of economic analysis, and subsequent policy recommendations for rural development, may vary among research projects.

One can conceive of a continuum of areal observational units, beginning with the Nation as a single unit and disaggregating geographically through the four census regions to nine census divisions, 50 States, 500 multicounty areas, 3,000-plus counties, and less-than-county units. At each level of disaggregation, one might have alternative delineations. For example, the 500 multicounty areas might be delineated in two or more different ways.

The optimal choice of an areal delineation depends upon the objective in view. In this paper, the comparison of alternative delineations is made from the point of view of analyzing rural development problems. Other points of view, such as implementation of political programs or health programs, might as easily be taken as the primary objective. The burden of this paper is not on how to choose the optimal delineation given an objective, but rather to show that, whatever the objective in view, the statistical results are a function of the delineation used.

From the point of view of rural economic development, up to a point, increasing levels of disaggregation of areal observational units are likely to reveal additional local development problems. However, if the disaggregation is carried to county and less-than-county levels, the observational units may be fractured into areas that do not contain the entire local economic development problem and/or means to help solve the problem. This suggests that analytic units which comprise less than a State but more than a county may be optimal, subject to considerations of the concepts as to what comprises a functional economic area. This point is discussed further in the appendix.

Alternative Delineations and Specific Variables

Nine delineations and 12 specific economic indicators were selected for the purpose of examining the consequences of alternative regional delineations. The nine delineations are for the 48 contiguous States and the District of Columbia. Listed in order of the number of observational units defined, they are:

1. 3,068 counties (COUNTY)
2. 509 governor delineated districts (A-95)[1]
3. 507 State Economic Areas (SEA)
4. 489 Rand McNally Basic Trading Areas (MCBTA)
5. 472 Basic Economic Research Areas (BERA)
6. 171 Office of Business Economics Regions (OBE)
7. 119 Economic Subregions, which are aggregates of State Economic Areas (SUBSEA)
8. 49 Rand McNally Major Trading Areas, which are aggregates of the Rand McNally Basic Trading Areas (MCMTA)
9. 49 States including the District of Columbia (STATES)

These nine delineations range from individual counties through States. Counties were used as building blocks in forming each delineation. The logic underlying the delineations varies from functional economic considerations, through homogeneity criteria, to political subdivisions. A more detailed discussion of these alternative delineations is in the appendix.

The 12 specific economic and social indicators are:

1. Percentage of population urban, 1960 (URBAN)
2. Percentage of population farm, 1960 (FARM)
3. Percentage of employment white-collar, 1960 (WH COL)
4. Percentage of employment finance, insurance, and real estate, 1960 (FIRE)
5. Income per capita, 1960 (IN/CAP)
6. Percentage of families, 1960, with 1959 income less than $3,000 (POVERT)
7. Percentage of housing units sound, 1960 (HOUSE)
8. Percentage of persons age 25 and over with high school or more education, 1960 (EDUCAT)
9. Percentage of commercial farms with sales greater than $10,000, 1964 (COMFRM)
10. Retail sales per capita, 1963 (RS/CAP)
11. Bank deposits per capita, 1960 (BD/CAP)
12. Local government expenditures per capita, 1962 (GE/CAP)

These 12 variables cover a broad spectrum of economic and social attributes. Some are measures of inputs to the development process, others are outputs, while some fill both roles simultaneously. Still other variables play neither role but function as characteristics that differentiate the development process of one region from the process of another region.[2]

The nine delineations vary from highly disaggregated (3,068 counties) to highly aggregated (48 States and the District of Columbia). Similarly, one can look at each of the 12 variables separately or aggregate them, even into a single index. Two general approaches to determining differences in statistical properties of the alternative delineations were undertaken. In the first, the 12 variables were combined into a single index reflecting the general level of economic development of an area. In the second, properties of each variable, and relationships among the variables, were compared for alternative delineations.

Statistical Properties When Specific Variables Are Aggregated

The 12 variables were aggregated into a single index of economic development by means of principal component analysis. The procedure assigns weights to each variable. The resulting index can be used to rank areal observational units. That is, counties can be ranked from 1 to 3,068, and States from 1 to 49, in terms of the level of economic development.[3]

Principal component weights for each of the 12 specific variables were calculated for each of the 9 delineations (table 1). Results obtained for each delineation showed that the principal component computations are not very sensitive to variations in delineations. The difference between each coefficient and the comparable BERA coefficient was calculat

[1] The governors had, at the time of writing, delineated 487 regions in 39 States. ERS has filled in delineations for the remaining 9 States.

[2] For further discussion of the specific and general roles such variables play in an economic indicator system for rural development, see: Clark Edwards and Robert Coltrane. Economic and Social Indicators of Rural Development from an Economic Viewpoint. Paper presented at Annual Meeting, Southern Agr. Econ. Assoc., Richmond, Va., Feb. 1972.

[3] For a detailed discussion of an index of this type, see: Clark Edwards, Robert Coltrane, and Stan Daberkow. Regional Variations in Economic Growth and Development with Emphasis on Rural Areas. U.S. Dept. Agr., Agr. Econ. Rpt. 205, May 1971.

Table 1.—Specific variables and their weights used to construct an index of economic development for alternative subregional delineations

Specific variables	Principal component weights								
	COUNTY	A-95	SEA	MCBTA	BERA	OBE	SUBSEA	MCMTA	STATES
URBAN	0.2686	0.2894	0.2954	0.2822	0.2780	0.2792	0.2907	0.2927	0.3050
FARM	−.2178	−.2161	−.2459	−.2027	−.2194	−.1957	−.2268	−.2080	−.2398
WH COL	0.3211	0.3157	0.3156	0.2964	0.3119	0.3110	0.3153	0.3040	0.3197
FIRE	0.2744	0.2707	0.2782	0.2458	0.2527	0.2570	0.2810	0.2719	0.2859
IN/CAP	0.3530	0.3476	0.3421	0.3580	0.3569	0.3503	0.3307	0.3231	0.3412
POVERT	−.3413	−.3343	−.3253	−.3296	−.3403	−.3283	−.3169	−.3041	−.3222
HOUSE	0.3498	0.3392	0.3353	0.3438	0.3444	0.3349	0.3265	0.3225	0.3345
EDUCAT	0.3280	0.3091	0.3038	0.3100	0.3112	0.3042	0.2938	0.2852	0.2612
COMFRM	0.2094	0.2176	0.1988	0.2380	0.2312	0.2358	0.2305	0.2814	0.1932
RS/CAP	0.2897	0.2845	0.2934	0.2888	0.2766	0.2905	0.2943	0.3097	0.2858
BD/CAP	0.2503	0.2555	0.2630	0.2672	0.2657	0.2667	0.2702	0.2390	0.2562
GE/CAP	0.2014	0.2447	0.2303	0.2618	0.2329	0.2733	0.2650	0.3002	0.2839

ed.[4] The average of the absolute differences ranged from less than 0.01 for the A-95 areas to about 0.03 for the Rand McNally Major Trading Areas (MCMTA). We do not know of a test of significance for the differences among principal component weights computed from correlation matrices from different populations. Instead, the specific variables were aggregated into an index for individual multicounty areas and a test was made of the ranks to determine if they were significantly different.

To do this, each of the nine sets of weights in table 1 was applied to the 472 observational units in the BERA delineation. This gave nine alternative indexes for the BERA delineation. A test of rank differences between the nine indexes failed to discriminate significantly among the alternative delineations. The smallest rank correlation coefficient, indicating the largest difference in ranks, computed between the BERA's ranking with its own set of weights and with an alien set of weights, was .9992 (table 2). This ranking was the one associated with weights derived from State data. The widest single variation in ranks was found in an instance where a State vector placed an area 42 ranks away from where the county vector placed it.

[4] The BERA delineation was chosen as the basis for comparison because it most closely follows the logic of functional economic areas. That is, from the point of view of economic development, for reasons external to the objective of this paper, the BERA delineation is considered useful. The purpose of this paper would have been met equally well with some other areal delineation chosen as the basis for comparison.

Statistical Properties When Specific Variables Are Not Aggregated

The nine delineations were compared for differences in descriptive properties of each variable and for differences in estimated relationships among variables. To examine descriptive properties, the mean, variance, and degree of skewness of a specific variable were compared among delineations. To examine relationships, correlation and regression coefficients were compared among delineations.

Descriptive Properties of Specific Variables

The analysis displayed quite a bit of variation in the first, second, and third moments for each specific variable for alternative delineations. In the two sections below, we discuss the variations in the first and third moments. The second moment was used in constructing some of the statistical tests.

Means.—Table 3 lists the mean and standard error of the mean for each of the 12 specific variables for the BERA delineation. For the other eight delineations, table 3 shows for each variable the extent to which the mean differed from the BERA mean using the BERA standard error as a unit of measurement. For example, the BERA mean for percentage of population urban was 50.15. The COUNTY mean for the same variable was 31.8 percent, 20.43 standard errors smaller than the BERA mean.

Table 2.—Test of difference in ranking of multicounty areas by weights derived from alternative delineations using the BERA delineation as a base

Item	COUNTY	A-95	SEA	MCBTA	OBE	SUBSEA	MCMTA	STATES
Rank correlation coefficient	0.99982	0.99992	0.99973	0.99978	0.99969	0.99980	0.99946	0.99917
Rank of coefficient	2	1	5	4	6	3	7	8
Maximum single deviation from BERA rank	15	7	14	12	13	13	19	27
Rank of deviation	6	1	5	2	3.5	3.5	7	8

Table 3.—Indicator of differences in means of specific variables for alternative delineations using the BERA delineation as a base

Specific variables	Standard errors from BERA[a,b]								BERA	
	COUNTY	A-95	SEA	MCBTA	OBE	SUBSEA	MCMTA	STATES	Mean	Standard error
URBAN. . . .	−20.43	−2.71	4.68	2.55	7.37	4.88	15.72	13.98	50.15	0.8994
FARM.	14.89	2.00	−5.17	−4.01	−4.35	−2.44	−11.11	−9.62	15.11	0.5152
WH COL . . .	−18.77	−2.45	2.59	1.38	6.08	2.90	6.84	13.70	35.99	0.2639
FIRE	−13.55	−0.56	4.87	1.82	8.97	7.48	19.12	18.06	2.90	0.0466
IN/CAP . . .	−12.13	−2.38	1.98	1.20	3.15	−0.18	8.39	10.81	1,550.88	16.3949
POVERT . . .	12.73	2.28	−1.59	−2.01	−2.19	1.52	−4.67	−7.88	28.27	0.5758
HOUSE . . .	−13.68	−2.36	2.59	2.44	3.53	−0.10	7.59	9.09	64.88	0.5869
EDUCAT . . .	−6.73	−2.31	−2.21	−1.30	1.18	−4.35	2.29	5.35	39.34	0.4010
COMFRM . .	−5.48	−2.35	−2.28	−1.81	−0.95	−3.52	−2.91	1.02	41.69	0.7880
RS/CAP . . .	−15.13	−3.02	−3.67	−1.68	−0.55	−4.66	−0.90	3.76	1,263.54	11.0108
BD/CAP . . .	−9.45	−1.34	0.11	−0.01	2.77	2.50	8.22	13.53	931.50	16.9974
GE/CAP . . .	−5.62	−4.24	−3.85	−3.03	−1.82	−5.16	−1.44	0.05	197.83	2.9215
Total of absolute values . . .	148.59	28.00	35.59	23.24	42.91	39.69	89.20	106.85	—	—
Mean of absolute values . . .	12.38	2.33	2.97	1.94	3.58	3.31	7.43	8.90	—	—

[a]A mean less than 1.96 standard errors from BERA is not significantly different at the .05 level. A mean less than 2.59 standard errors from BERA is not significantly different at the .01 level.

[b]Computed with the formula, $\frac{\bar{x}_j - \bar{x}_{BERA}}{\text{standard error}}$.

An indicator of the degree of closeness of a vector of means to the BERA means was constructed as the sum of absolute values of differences from the BERA means. The Rand McNally Basic Trading Areas (MCBTA) had means which, on average, were closer to the BERA means than any other delineation. The sum for the MCBTA's totaled 23.24, an average of 1.94 standard errors. The A-95 and SEA delineations also have means very close to the BERA means, so BERA, MCBTA, A-95, and SEA delineations would be expected to give about the same average picture of the levels of the specific variables. The sizes of the indicators for the COUNTY, STATE, and MCMTA delineations suggest altogether different average pictures.

Skewness.—Indicators of differences in skewness of specific variables for alternative delineations, using the BERA delineation as a base, are shown in table 4. The coefficient of skewness was calculated according to the formula:

$$a = \frac{1}{N} \Sigma \left(\frac{x_j - \bar{x}_j}{s_{x_j}} \right)^3$$

If the sample comes from a normal population, it is distributed with a mean of zero and a standard deviation of:

$$s_a = \left(\frac{6}{N} \right)^{1/2}, \text{ when } N \text{ is large.}$$

The ratio, a/s_a, measures the number of standard deviations the observed coefficient of skewness is from zero. This ratio is tabulated for the BERA delineation in table 4. For example, the BERA coefficient of skewness for percentage of population urban was 1.06 standard deviations above zero. A coefficient above zero suggests a distribution that is skewed to the right. However, a ratio less than 1.64 rejects the hypothesis of skewness at the .05 level for large N. So the percent urban variable is apparently not skewed significantly. Following these rules, eight of the 12 variables are skewed in the BERA delineation. Of these, the quality of housing variable is skewed to the left; the other seven, to the right. The four variables that appear to be normally distributed are percent urban (URBAN), income per capita (IN/CAP), percent with a high school education (EDUCAT), and percent of commercial farms with sales over $10,000 (COMFRM).

The differences between BERA's ratio of the coefficient of skewness to its standard deviation and the ratio for each of the other eight delineations are shown in table 4 for each of the 12 specific variables. For example, while the BERA coefficient of skewness for the percentage of population urban was 1.06 standard deviations above zero, the comparable coefficient for the counties was 9.32 standard deviations above zero, 8.26 standard deviations higher than BERA. This means this variable was significantly skewed to the right for counties whereas it appeared not to be skewed for the BERA's.

Table 4.—Indicator of differences in skewness of specific variables for alternative delineations using the BERA delineation as a base

Specific variables	Differences in skewness from BERA[a]								BERA[b]
	COUNTY	A-95	SEA	MCBTA	OBE	SUBSEA	MCMTA	STATES	
URBAN	8.26	0.74	-0.36	1.80	0.06	-0.76	-1.47	-0.97	1.0648
FARM	5.05	-1.02	1.00	.56	-3.37	-4.25	-6.90	-6.82	7.9503
WH COL	11.80	1.52	-0.03	1.33	-1.28	-3.50	-3.82	-3.86	3.6380
FIRE	22.70	1.35	0.32	2.45	-6.09	-8.48	-10.92	-10.93	11.7838
IN/CAP	12.12	1.29	-0.75	-.08	-0.30	-0.35	-1.12	-1.01	1.0382
POVERT	.42	-1.47	0.35	-.07	-3.76	-4.88	-6.34	-5.94	7.0275
HOUSE	-1.47	.16	-1.26	-.49	2.48	2.82	3.54	3.33	-4.0106
EDUCAT	3.70	.11	.44	1.50	.99	.68	.97	.90	1.1535
COMFRM	4.82	-.17	.78	.66	.40	.52	-.04	-.68	-0.2130
RS/CAP	-.40	-1.81	-2.76	2.45	-1.18	4.17	-3.05	-1.82	2.7240
BD/CAP	47.06	22.81	3.95	.64	-2.92	-5.10	-12.87	-12.75	15.8740
GE/CAP	36.94	-.63	.38	-.34	-3.61	-4.25	-6.45	-5.56	7.2408
Total of absolute values	154.74	33.08	12.38	12.37	26.44	39.76	57.49	54.57	—
Mean of absolute values	12.90	2.76	1.03	1.03	2.20	3.31	4.79	4.55	—
Standard deviation[c]	.0447	.1089	.1086	.1109	.1844	.2199	.7946	.7946	.1127

[a]Differences in skewness from BERA was computed with the formula, $\frac{a_j}{s_{a_j}} - \frac{a_{\text{BERA}}}{s_{a_{\text{BERA}}}}$, where a = coefficient of skewness and s_a = standard deviation.

[b]The number of standard deviations (s_a) the coefficient of skewness (a) is from zero. This was computed with the formula, $\frac{a_{\text{BERA}}}{s_{a_{\text{BERA}}}}$.

[c]The standard deviations (s_a) were computed with the formula, $s_a = \sqrt{6/N}$ when N was greater than 200. When N was less than 200, the values for s_a were interpolated from appendix table A6, page 552 in Snedecor and Cochran, Statistical Methods, Iowa State University Press, Ames, Iowa, 6th edition, 1967.

An indicator of the degree of closeness of a vector of coefficients of skewness to the BERA vector was constructed. This indicator was the sum of the absolute value of differences from the BERA coefficients. This sum totaled 12.37 for Rand McNally Basic Trading Areas (MCBTA) and 12.38 for State Economic Areas (SEA), an average difference of only 1.03 standard deviations. The variables in the OBE and A-95 delineations were also close to BERA in terms of skewness. The COUNTY variables had by far the greatest average difference from BERA in skewness.

Thus, the comparisons of means, variances, and coefficients of skewness show that the descriptive properties of a specific variable are a function of the delineation. The BERA, MCBTA, A-95, SEA, and OBE appear to have similar descriptive properties.

Relationships Among Specific Variables

So far, it has been shown that generating aggregative economic indicators, such as simple rankings of regions in terms of level of economic development, is not particularly sensitive to alternative delineations. However, descriptive properties of specific variables, such as the mean, variance, and skewness, are sensitive. In this section, we examine whether relationships among variables, such as simple correlations and single equation regressions, are sensitive to alternative delineations.

Correlations.—Indicators of differences in simple correlation coefficients for specific variables, using the BERA delineation as a base, are shown in table 5. Simple correlation coefficients were calculated among the 12 variables for each delineation. That is, for each delineation, each variable was correlated with 11 other variables. The 99-percent confidence limits were calculated for each BERA correlation coefficient. Finally, it was determined whether each corresponding coefficient for the other eight delineations fell within the confidence limits for the BERA coefficients. The number of correlation coefficients for each specific variable that were outside the confidence interval for the comparable BERA coefficients is shown in table 5.

Five of the 11 correlation coefficients for the percent urban variable in the COUNTY delineation fell outside the 99-percent confidence limits for the BERA coefficients. For the percent urban variable, the SUBSEA delineation had the most coefficients (11) that

were significantly different, while the OBE delineation had only one coefficient falling outside the confidence limits.

An indicator of the degree of closeness of the correlation coefficients for the eight alternative delineations to BERA was constructed by summing the number of coefficients for each delineation that was significantly different from BERA. This total for the Rand McNally Basic Trading Areas (MCBTA), with double counting removed, was 10. This indicates that the correlation matrices for the Rand McNally Basic Trading Areas and for BERA are relatively similar. The governors' districts under A-95 and the Office of Business Economics delineation (OBE) also had correlation matrices similar to the BERA matrix. The State Economic Area (SEA) matrix was quite dissimilar to the BERA matrix with 33 coefficients, or half of the 66 computed, significantly different. Thus, while the SEA delineation earlier showed little difference from BERA's in terms of descriptive properties of each variable such as central tendency, here it shows considerable difference in terms of structural interrelationships. This is probably because the SEA's were delineated on the basis of homogeneity of specific attributes, whereas the BERA's were delineated on the basis of functional economic considerations. Hence, both have about the same descriptive content but are structurally dissimilar. The delineation that showed the greatest difference in the correlation matrix from the BERA matrix was the Economic Subregions (SUBSEA), where 59 of the 66 elements were significantly different (table 5).

The problem of correlation coefficients varying among areal units was discussed by King.[5] He cites several studies that also discuss the problem. King quotes Yule and Kendall[6] as saying that "correlations will . . . measure the relationships between the variates for specified units chosen for the work. They have no absolute validity independently of those units, but are relative to them." We agree with Yule and Kendall in general, but we find that measures of relationships between variables have some validity for other observational units delineated with similar criteria. For example, we might be able to use MCBTA correlations, but not SEA correlations, to analyze BERA units. Or, stated another way, one could expect about the same results using either MCBTA or BERA correlations, but quite different results using SEA correlations.

Regressions.—Stepwise regressions on the 12 variables further demonstrate that estimates of economic structure are a function of the regional delineation. The right-hand column of table 6 shows the order in which each specific variable entered a stepwise regression, using the BERA delineation. In this regression, income per capita was treated as the dependent variable to be explained by the other 11 variables. The intensity of poverty (POVERT) was the first variable to enter the BERA regression; the percent with a high school education (EDUCAT) was the last to enter. Also shown

[5] Leslie J. King. Statistical Analysis in Geography. Prentice-Hall Inc., Englewood Cliffs, N.J., 1961, pp. 154-7.

[6] G. V. Yule and M. G. Kendall. An Introduction to The Theory of Statistics. Hafner Publishing Co., New York, N.Y., 1950, p. 312.

Table 5.—Indicator of differences in simple correlation coefficients for specific variables for alternative delineations using the BERA delineation as a base

Specific variables	Number of correlation coefficients that were significantly different from comparable coefficient in the BERA delineation[a]							
	COUNTY	A-95	SEA	MCBTA	OBE	SUBSEA	MCMTA	STATES
URBAN	5	5	9	4	1	11	8	9
FARM	2	0	7	2	0	9	5	8
WH COL	1	4	6	5	2	10	7	7
FIRE	2	3	9	2	1	11	6	10
IN/CAP	3	3	6	1	3	9	8	8
POVERT	3	2	4	1	2	10	7	6
HOUSE	0	1	7	2	3	11	9	8
EDUCAT	2	1	4	0	1	7	6	4
COMFRM	2	0	0	0	0	9	10	5
RS/CAP	8	4	7	0	5	11	10	9
BD/CAP	2	0	4	0	1	9	3	5
GE/CAP	4	1	3	3	7	11	11	2
Total with double counting removed	17	12	33	10	13	59	45	44

[a] The number of correlation coefficients falling outside the 99-percent confidence limits of the BERA correlation coefficients. For each delineation, the maximum number for each variable is 11 and the maximum number for each column total is 66.

Table 6.—Order in which specific variables enter a stepwise regression for alternative subregional delineations using the BERA delineation as a base for comparisons

Specific variables[a]	Differences from BERA order ($x_j - x_{BERA}$)								BERA order
	COUNTY	A-95	SEA	MCBTA	OBE	SUBSEA	MCMTA	STATES	
URBAN . . .	−6	−7	−4	0*	0*	−4	−4	−6	4*
FARM	−4	−1*	−4	−3*	−2	−4	−4	4*	7*
WH COL . . .	0*	2*	4*	0*	4*	1	0	−2	6*
FIRE	0*	0*	−8	0*	−9	0*	0*	−7	2*
POVERT . . .	0*	0*	0*	0*	0*	0*	0*	−5	1*
HOUSE . . .	2*	0*	5*	2*	−1	5*	−1	8*	9
EDUCAT . . .	8*	5*	5*	0*	6*	4	7*	4	11
COMFRM . .	1*	0	1	2*	3*	1	3	−1	10
RS/CAP . . .	−5*	0*	−4*	0*	0*	−3	−2*	1*	3*
BD/CAP . . .	1*	0*	2*	0*	−3*	2*	−4	1*	5*
GE/CAP . . .	3*	1*	3*	−1*	2*	−2*	5*	3	8*
Total of positive values . . .	15	8	20	4	15	13	15	21	—

[a]Income per capita was the dependent variable.

*Specific variables which would have been in an equation selected by stepwise regression such that each variable in the equation is significant at the .05 level.

in table 6 is a measure of the difference from the BERA order that the 11 variables entered regressions for the other delineations. For example, the percent urban variable, which entered fourth in the BERA regression, entered six steps later, or tenth, in the COUNTY regression.

An indicator of the similarity to the BERA order in which variables entered a stepwise regression for the other delineations was calculated by summing the positive differences (table 6). The regression with an ordering closest to the BERA order was the Rand McNally Basic Trading Areas (MCBTA). The A-95 areas were also fairly similar in structure to the BERA areas. The States and the State Economic Areas (SEA) show the greatest difference in economic structure from the BERA areas by this criterion. The magnitude of the difference in the SEA ordering from the BERA ordering is not surprising due to the earlier finding that the correlation coefficients were quite different. This is especially interesting considering that the descriptive properties for SEA's and BERA's were quite similar in terms of means, variances, and skewness.

As an alternative to stepwise regression, a single equation model to explain income per capita with five independent variables was fitted for each of the nine delineations. The model was:

$$\text{IN/CAP} = a + b_1\ \text{URBAN} + b_2\ \text{FIRE} + b_3\ \text{POVERT} + b_4\ \text{RS/CAP} + b_5\ \text{BD/CAP}.$$

This equation was obtained from the first five steps in the stepwise regression using the BERA areas.

Using this model, four of the nine delineations generated coefficients which were statistically significant at the .01 level for all five independent variables. One delineation, of course, was BERA. The other three were A-95, MCBTA, and SEA (table 7). Only three of the five coefficients were significant at this level for States and for Rand McNally Major Trading Areas (MCMTA).

Not only were the coefficients for BERA, A-95, MCBTA, and SEA all significantly different from zero (table 7), they were different from each other (table 8).

Conclusions.—The discussion of correlation coefficients and stepwise regressions suggested that three delineations, BERA, MCBTA, and A-95, were much alike in terms of an apparent economic structure that reflects relationships among specific variables. Structure estimated for one of these delineations might be used for analysis of relationships in the other two.

The structure estimated with the SEA delineation was different from the estimated structure of the BERA, MCBTA, and A-95 delineations. However, when the specific, five-independent-variable model was fitted for all delineations, the SEA's generated coefficients which were close to those found for the BERA, A-95, and MCBTA delineations. The SEA's gave the right answers for the wrong reasons. They have an underlying structure different from the BERA structure; 10 of the 15 correlation coefficients involved in the model were significantly different from the BERA correlation coefficients. Further, 11 independent variables entered a stepwise regression equation using the SEA units in an order different from that of the variables entered using the BERA units. Thus, it seems the SEA's were able to generate about the same estimates of structure for the five-independent-variable model as the BERA's because

Table 7.—Constant terms, partial regression coefficients and coefficients of determination for alternative subregional delineations[a]

Subregional delineation	Relative frequency of significant variables			Constant term	Partial regression coefficients[b]					Coefficient of determination
					URBAN	FIRE	POVERT	RS/CAP	BD/CAP	
	†	*	**			**	**	**	**	
COUNTY	1	0	4	1,746.008	0.193	51.005	−18.865	0.096	0.066	0.85
					(0.143)	(3.357)	(0.238)	(0.011)	(0.009)	
					**	**	**	**	**	
A-95	0	0	5	1,580.331	1.961	39.211	−18.934	0.183	0.066	0.91
					(0.405)	(7.156)	(0.637)	(0.030)	(0.017)	
					**	**	**	**	**	
SEA	0	0	5	1,591.522	(1.926)	28.139	−19.093	0.194	0.090	0.92
					(0.366)	(6.275)	(0.620)	(0.030)	(0.017)	
					**	**	**	**	**	
MCBTA	0	0	5	1,465.273	2.971	41.004	−18.725	0.215	0.072	0.91
					(0.390)	(6.171)	(0.580)	(0.028)	(0.016)	
					**	**	**	**	**	
BERA	0	0	5	1,502.328	2.484	33.017	−18.475	0.207	0.095	0.90
					(0.417)	(7.234)	(0.655)	(0.030)	(0.019)	
					**	*	**	**	**	
OBE	0	1	4	1,255.269	4.728	22.215	−17.678	0.328	0.072	0.94
					(0.691)	(11.216)	(1.056)	(0.049)	(0.024)	
					**		**	**	**	
SUBSEA	1	0	4	1,367.816	3.489	17.899	−16.856	0.262	0.108	0.95
					(0.869)	(15.180)	(1.284)	(0.071)	(1.027)	
					*		**	**	**	
MCMTA	1	1	3	1,107.007	4.179	−2.358	−16.347	0.493	0.114	0.95
					(1.609)	(30.600)	(2.632)	(0.157)	(0.039)	
					**		**	**		
STATES	2	0	3	951.350	6.926	18.767	−15.071	0.440	0.048	0.94
					(1.519)	(26.727)	(2.275)	(0.092)	(0.036)	

[a]Income per capita was the dependent variable.
[b]Values in parentheses directly below the partial regression coefficients are the corresponding standard errors (s_b).
*t value significant at the .05 percent level.
**t value significant at the .01 percent level.
†Not significant.

(1) the model was imposed on the SEA's, (2) the descriptive properties of the five explanatory variables were about the same as the BERA's in terms of means, variances, and skewness, and (3) there was a high correlation between some of the independent variables for the SEA delineation with some variables not in the equation; e.g., WH COL was highly correlated with URBAN and FIRE in the SEA's.

The OBE delineation had a structure somewhat similar to the BERA structure. Fifty-three of the 66 correlation coefficients computed for the OBE regions were not significantly different from the BERA

Table 8.—Test of differences in regression coefficients derived from alternative delineations using the BERA delineation as a base

Subregional delineation	Significance of differences from BERA regression coefficients				
	URBAN	FIRE	POVERT	RE/CAP	BD/CAP
COUNTY	*	—	**	—	*
A-95	*	**	**	**	*
SEA	*	**	**	**	**
MCBTA	*	*	**	**	*
OBE	—	*	*	—	*
SUBSEA	—	—	—	*	**
MCMTA	—	—	—	—	**
STATES	—	*	—	—	—

—Coefficient is more than 2 standard deviations from BERA coefficient.
*Coefficient is more than 1 and less than 2 standard deviations from BERA coefficient.
**Coefficient is less than 1 standard deviation from BERA coefficient.

coefficients. Further, the OBE data reproduced the BERA coefficients for the regression model fairly well. However, there was enough difference in the order in which the variables entered the stepwise regression model for the OBE regions to warn against applying conclusions drawn from analyzing OBE regions to problems defined for the BERA's. The States seemed to diverge most from the BERA's in terms of relationships among specific variables.

Summary

There are a number of possible geographic delineations that can be used for areal allocation of population, income, employment, and other social and economic characteristics in a rural development indicator system. In this paper, it was shown that estimates of statistical parameters vary for alternative geographic aggregations and for alternative delineations at a given level of aggregation. It was also shown that estimates of statistical parameters for alternative delineations vary as the level of structural disaggregation of variables used in the analysis is varied. Two approaches to determining differences in statistical properties of alternative delineations were undertaken. In the first, 12 variables were combined into a single index reflecting the general level of economic development of an area. In the second, properties of each variable, and relationships among variables, were compared for alternative delineations. When the 12 variables were aggregated in a single index of economic development, a test of rank differences between indexes for nine alternative delineations failed to discriminate significantly among delineations. However, when the 12 variables remained disaggregated, differences in values for means, variances, and coefficients of skewness indicated that the descriptive properties of specific variables are a function of the delineation. Finally, differences in correlations and regression coefficients suggested that estimates of economic structure vary among delineations.

Appendix

From the point of view of economic development, present political delineations, e.g., cities, counties, and States, do not necessarily coincide with the geography of the local economic development problem. Therefore, some aggregation of local juridsictions must be used as units of analysis for rural development purposes. Some attempts to deal with delineation problems appear to be unsatisfactory because contiguous counties are aggregated on the basis of homogeneity of economic and social problems, or on the basis of specific differentiating characteristics such as proportion of residents living outside urban areas. These approaches overlook the interdependencies of people who live, work, shop, and play within commuting range of one another. Residents outside urban centers depend on access to these centers for markets for their products or their labor; for producer and consumer goods; and for various services relative to health, education, and welfare. Urban centers depend on residents of the hinterland as consumers and for their labor.

The concept of functional economic areas has been described by Karl A. Fox.[7] An empirical effort to delineate the United States into functional economic areas was reported by Brian Berry.[8] Berry and Fox used journey-to-work patterns both in theory and in practice. Berry's delineation did an excellent job of suggesting functional economic areas for those parts of the United States which had sufficient journey-to-work activity centered on urban places reported in the 1960 Population Census. One weakness in Berry's delineation is that it did not include all areas in the Nation. Berry left out about 4 percent of the U.S. population. That amounted to more than 7 million rural people in 1960, or about 14 percent of the total 1960 rural population. What is needed is a logical set of areas covering the entire geographic area of the United States. Five such delineations are discussed below. Two of the five have delineations at two levels of geographic aggragation. These seven, plus States and counties, make up the nine alternative delineations examined in the text.

State Economic Areas.—A delineation of all 3,000-plus counties in the 48 States into 507 State Economic Areas was reported by Bogue and Beale.[9] These areas have the advantage of including the entire population and provide for useful comparisons of economic and social characteristics among areas. However, a homogeneity logic was used rather than a functional interdependence logic. The 507 State Economic Areas were aggregated into 119 Economic Subregions.

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[7] Karl A. Fox and T. Krishna Kumar. "Delineating Functional Economic Areas." In Research and Education for Regional and Area Development, Iowa State Center for Agr. and Econ. Devel., Iowa State Univ. Press, Ames, Iowa, 1966, pp. 13-55.

[8] Brian J. L. Berry. Metropolitan Area Definition: A Re-Evaluation of Concept and Statistical Practice. Working Paper No. 28, U.S. Dept. Commerce, June 1968.

[9] Donald J. Bogue and Calvin L. Beale. Economic Areas of the United States. The Free Press of Glenco, N.Y., 1961.

Rand McNally Trading Areas.—A delineation of all counties in the 48 States into 489 basic trading areas was presented by Rand McNally.[10] These multicounty areas closely approximate functional economic areas in the sense of having a dominating central city that influences the immediate urban area as well as the surrounding rural area. The logic is of trading area linkages rather than the journey-to-work logic of Fox and Berry. The 489 Rand McNally Basic Trading Areas were aggregated into 49 Major Trading Areas.

Office of Business Economics Regions.—A delineation of 171 multicounty areas was prepared by the Office of Business Economics. Three basic guidelines were used to delineate these areas: They were to include all counties; they were to be large enough so that estimates of income and other economic and social attributes would have statistical reliability; and, they were to conform to functional economic area logic to the extent that limited time and research budgets permitted. These areas are useful units of analysis for many subnational problems, but many of the areas are so large in terms of trading and commuting patterns that local development problems are often averaged out.

Governors' Delineations Under A-95.—Another altogether different line of historical development in area delineation followed from efforts by the Bureau of the Budget to coordinate development programs and planning at the Federal level. Guidelines to encourage the use of common boundaries of planning and development districts when Federal assistance is involved appeared in 1967 in Circular A-80. Subsequent circulars, particularly A-95, released in 1969, added further impetus to delineation of multicounty planning and development districts by the governors of the various States. So far, 39 governors have responded by delineating their States into 487 substate districts. Estimates by ERS as proxies of what will evolve when the other nine States delineate suggest that this process will result in possibly 509 multicounty districts covering all counties in the 48 conterminous States. The logic underlying the delineation seems to vary from careful application of functional economic logic to application of largely political considerations. In any event, these areas are about the right size on the average and they have the advantage of fitting into a political organization for policy implementation.

Basic Economic Research Areas.—The Economic Research Service has delineated all counties in the 50 States into 482 multicounty areas. There are 472 areas in the 48 contiguous States. Berry's commuting pattern and Rand McNally's trading area logic were considered in this effort. ERS also considered size of the largest city and travel conditions so that commuting from the fringe of an area to its center could be feasible whether or not commuting was reported by the Bureau of the Census. Most of the multicounty areas obtained by this procedure appear to conform closely to the idea of a functional economic area with an urban center and an interrelated hinterland. But, of course, it contains several rural areas that are sparsely populated and have villages or small towns as their "center." These areas cross State lines where functional considerations appear to warrant it.

[10] 1972 Rand McNally Commercial Atlas and Marketing Guide. Rand McNally and Co., Chicago, Ill.

BOOK REVIEWS

Industrial Market Structure and Economic Performance

By Frederick M. Scherer. Rand McNally and Company, P.O. Box 7600, Chicago 60680. 576 pages. 1970. $13.

Scherer's book is the "new bible" of market structure, conduct, and performance. It is an excellent summary of the state of the arts. The coverage of the literature is extensive, except for that of agricultural economics. I counted only two references to work by agricultural economists, except that published in general economic journals. Surely the extensive economies-of-scale studies by agricultural economists using the economic-engineering method are at least worthy of mention.

The discussion of economies of scale includes plant economies, vertical integration, technological change, market growth, the economies of multiplant operation, sales promotion, pecuniary economies, and research and development. The coverage of plant economies of scale is limited to multi-industry studies using statistical relationships between plant size and long-run unit cost for various industries, and the so-called engineering approach which utilizes questionnaires to engineering executives in various industries who estimate the minimum optimum scale. It ignores the economic-engineering techniques widely used by agricultural economists and the adaptation thereof called process analysis (i.e., linear programming) which has been used in some studies of the petroleum refining industry.

Possible scale economies—or diseconomies—in procurement and other aspects of management are ignored. This, of course, reflects the dearth of empirical investigation of these matters. It seems a reasonable hypothesis that there are considerable economies of scale in procurement, some of which at least could be quantified. On the question of management economies or diseconomies to scale, both hypotheses have their admirers. Anyone who has ever suffered with a large bureaucracy—whether it be the Army, the telephone company, or a university—can testify to considerable diseconomies of size in their operations. Whether these are offset by other, less visible economies is an interesting question. Not the least of the possible diseconomies of scale in a large corporation are those arising from the deceptions which such an organization sometimes practices upon itself through its accounting conventions. One wonders how many subsidiaries have been divested because they were losing money, when the chief problem was that the transfer prices adopted put the profits in some other portion of the corporation.

Scherer's coverage of economies of scale is an excellent example of the indication of the state of the arts which he provides to economists interested in market structure, conduct, and performance. We know something about plant economies, and a fair bit about the economies of scale in research and development (an area in which Scherer has worked and on which he provides substantial coverage); and we have some ideas about economies of scale in promotion and in financial management. On other points, economists have been largely silent.

Agricultural economists will be interested in the comment on the "peculiar rhythm" of investment caused by price-fixing schemes of German cartels (p. 319). When the price-fixing schemes were working well, outsiders were attracted into the industry, creating overcapacity. The resulting struggle for market share brought about the collapse of the cartels, prices dropped, and investment declined drastically. The analogy to supply control efforts by cooperatives will be apparent.

Scherer's treatment of product differentiation illustrates the homely truth which has too often escaped economists attempting to deal with the problems of structural analysis. He says, "the relevant question for economic analysis is not . . . whether product differentiation is a good thing, but rather, how much product differentiation there should be and whether certain market conditions might lead to excessive or inadequate differentiation" (p. 325). This statement illustrates the principle that a simple dichotomy of "good" and "bad" is inappropriate in dealing with the difficult questions of market performance. Most curves relating performance to some other characteristic are U-shaped—either inverted or upright. The optimum level is somewhere between the extremes. A clear exposition of this point should be required of all graduate students as a prerequisite to receiving the doctorate in any field relating to the analysis of market performance. At the same time, refresher courses should be required of all

present practitioners of the art, particularly those in regulatory agencies.

Alden C. Manchester

The Economy of Cities

By Jane Jacobs. Random House, 457 Madison Ave., New York 10022. 268 pages. 1969. $5.95 cloth; $1.95 paper.

Why review a book on cities? Because the first chapter, "Cities First—Rural Development Later," advances a radical, new theory as to the origins of agriculture. Mrs. Jacobs was so completely impressed with the drive and energy of cities, as the source of all technological advance throughout the history of mankind, that she extrapolated this observation backward into prehistory and concluded that the universally retarded rural types—hunters and gatherers all at that time—could not possibly have made the discoveries and the intricate combinations of facts and ideas that were necessary in the development of domesticated animals and cultivated crops—generally considered to have occurred between 9,000 and 7,000 B.C. So she postulated (1) the early development of cities as trade centers for hunting and gathering tribes, (2) the gradual development of agriculture by these cities, and (3) the ultimate ruralization of agriculture by a process of outward colonization from the cities.

The original objective was to explain the economic growth of cities—why some grow while others stagnate and decay—and this is attempted in chapters 2 through 8. To summarize more than 200 pages very briefly, cities grow when they add new work to old work—a process of innovation and development. Any settlement where the addition of new work proceeds rapidly becomes a city. However, growth and efficiency are not compatible. The success of a few large firms may bring efficiency—but also stagnation. Vigorous innovation depends on large numbers and great diversity of economic organization, so that fragmented and inefficient little industries, with much trial and error, are the best soil for city growth. What makes a city in the first place is the existence and growth of "export work"—work on products sold outside the city. An increase in such work has a multiplier effect because it induces increases in supportive enterprises. But eventually a growing city will tend to start production of goods it previously imported, and this "import replacement" has an even bigger effect because all shifted imports go to swell the local economy.

Stated thus barely, the theory may seem like circular reasoning: Cities grow because they add new work. But Mrs. Jacobs provides thorough discussion and many illustrations which transform her simple proposition into a respectable hypothesis. The theory is abundantly supported at every point by apt and stimulating illustrations drawn from all ages and many parts of the world, including the by now obligatory contrast between progressive (English) Birmingham and stagnating Manchester. And since the author obviously knows her subject thoroughly, her ideas on the origins of agriculture cannot be casually dismissed.

The reader is asked to imagine a preagricultural city, located on the Anatolian plateau of Turkey, and called New Obsidian after the hard volcanic substance assumed to be its original stock in trade. Mrs. Jacobs says there were many preagricultural cities based on trade in what were then "strategic" commodities—copper, pigments, amber, and sea shells, in addition to obsidian—and she seems to have some support among archeologists for this claim. However, obsidian was the most important industrial material traded in that part of the world because it made the sharpest cutting tools—not steel by any means, but the nearest thing to it then. Traders came to New Obsidian with the specific purpose of getting obsidian, not to get rid of something else. Consequently, they had to bring nonperishable produce of their hunting territories, which would be hard seeds and live animals—trussed and carried, or hobbled and driven.

The large flow of these commodities into the city would require specialists in their protection, storage, and distribution. Considerable judgment would be required in managing the inventory of live animals. First to be killed would be those animals, including most carnivores, that are hardest to feed or troublesome to manage. Animals that can live on grass would be "removed last from the natural refrigerator of life." And females, "being less rambunctious," would be kept longest, with the result that sometimes they would give birth before they had been slaughtered. The animal stewards would naturally save these docile breeders whenever they could. Perhaps sheep would become animals of choice because their meat was liked as well as any and their pelts were highly valued. Domestication would follow inevitably, however slowly.

The seed stewards, on the other hand, would have no reason to play favorites. Seeds would be mingled in storage and eaten as mixtures. Some seeds would be sown, deliberately in wild patches for convenience, through accidental spilling, or by rats, mice, and birds. Since the seeds would come from many and widely scattered areas, the plants would naturally cross in

unprecendented combinations—which would not go unobserved by the seed stewards. In fact, the inevitable crosses and hybrids would be seen by experts, well aware that some of the resulting "city seeds" were new. The better yielding varieties would naturally be preferred and selected. Nevertheless, it would take many generations—of people as well as of wheat and barley—to bring about the earliest cultivated grains. When agriculture had thus been developed in the city, why should it be transplanted to rural areas? The most likely reason, according to Mrs. Jacobs, would be the need for more space to pasture herds of animals. Thus, agricultural villages may have been set up, in a kind of colonization from the city, to handle part of the city's work.

Mrs. Jacobs thinks that the "current dogma of agricultural primacy" derives from pre-Darwinian thinking—more specifically from Adam Smith, who was professor of "moral philosophy" and believed, as did all educated men of his time, that the world was created in 6 days about 5,000 B.C. and that man was born into a "garden." For Adam Smith, therefore, agriculture was "given," men earned their bread by the sweat of their brows, and the only possible question was: How did commerce and industry arise upon an agricultural base? This was the right question for that time because there was no contrary evidence. But the question has unfortunately remained unchanged despite drastic alteration in both the available evidence and man's thinking on other fundamental questions.

For contrast with this theory, let us now review briefly the orthodox explanation of agricultural origins. This account is abstracted primarily from two publications: (1) "Climate, Man and History" by Robert Claiborne (W. W. Norton & Co., New York, 1970), and (2) "Valley to Valley, Country to Country" by Wayne D. Rasmussen (1964 Yearbook of Agriculture, pp. 1-11). Incidentally, the latter says that "civilization began when man planted his first seed and tamed his first animal" (p. 1), whereas the former says that the invention of agriculture resulted in a "transition from savagery to barbarism" (p. 238), with "civilization" and cities coming later—together.

The generally accepted theory argues that agriculture developed first in the Middle East—probably in Mesopotamia, or present-day Iraq—and that the transition was directly from a hunting and gathering life to agriculture, facilitated by a variety of climatic zones in a small area. With the relatively short distance of 150 miles required for migration from one zone to another, men followed the game from winter to summer pasture and back again as the seasons varied, taking advantage en route of the different growing seasons for plants at different altitudes, and taking only a month to 6 weeks for the journey each way. Thus, Mesopotamian man was much less of a wanderer than previous hunting and gathering tribes. Moving more slowly, he could carry more equipment and become more knowledgeable of the different localities, the result being that an incredibly varied diet was available to the hunter-collector who knew which plants and animals were available in each season in each environmental zone.

Animal husbandry probably developed when man succeeded in taming animals that had been wounded or driven into enclosures for slaughter, but it is also likely that the very human impulse to acquire pets was an important factor, and that the women of the tribe saved and tamed very young animals. Some recently acquired knowledge may be an important factor in understanding the early domestication of animals. Many young animals undergo a process known as "imprinting," by which they become attached to the first moving object with which they come in continuous contact. It is possible, therefore, that the original domestication of animals was not nearly as difficult as was previously thought, requiring only the initial impulse to save the very young. It would certainly have taken no great stroke of genius for hunters and their women, most probably the latter, to note the utility of having one's food supply hanging around the camp.

Wild wheat and barley will flourish over fairly wide environmental conditions provided only that the soil has been disturbed. Since man stored grain, seeds, and nuts even in his hunting and gathering stage, it was inevitable that accidental seeding—on the midden, or garbage heap, or on loose earth where children had been digging—would have occurred rather frequently. By spring, time to move up country again, the seeds would have sprouted and grown into wheat, which some thrifty "hutwife" would have gathered to supplement the family rations on the march. Since "man the hunter" left the gathering chores to women, it is quite likely that some primitive woman was the first to note the possibility and desirability of deliberately planting crops.

In any case, it would not have been long thereafter before the ground would be dug and seeds dropped deliberately, and a small plot may even have been left at each halting place for gathering on the return journey. In this connection, it is noteworthy that a pointed stick, the "digging stick," was the last tool of the food gatherer and the first tool of the farmer—for that which had been used to grub for roots also served to dig holes for seeds. The next step was for part of the tribe to settle down in a permanent camp, with the women, children, and old men staying put and cultivating wheat, barley, and eventually other crops, while the boys and younger men drove the tribal herds of sheep each spring up to the summer pastures, returning in the fall to the milder lowland climate—and probably to a festive tribal reunion.

It is likely that the mere moving of food plants would begin their improvement. For example, in wild wheat and barley the seeds are most commonly scattered widely from a dry and brittle rachis (stem). This would be a biological advantage, but a real nuisance to prehistoric reapers who would lose much of the grain in the process of harvesting it. In every field, however, there are likely to be a few mutants whose rachises are much tougher. This variation cannot spread under natural conditions, but it would be *preferred* by the primitive reapers, and it would not take many "biased" transfers of this sort to arrive at a new strain. This kind of fortuitous plant improvement may have gone on gradually for a long time, but eventually man would have learned to do by design what he had first done by accident. Thus, the crossing and hybridization of plants, which Mrs. Jacobs emphasizes as requiring a "city" environment, could have been started by accidental selection and continued by deliberate choice. All that was really required was the mixed storage of grains and seeds, the accidental sowing of these seeds, and some time and curiosity to observe the results.

What are we as agricultural economists to make of these two contradictory theories? First, we should note that there is no evidence constituting irrefutable proof on either side of the question, despite long and hitherto unquestioned acceptance of the primacy of agriculture. There is too much that is still unknown for dogmatism or closed minds on either side.

Recent studies on agricultural origins have been concerned with even more basic questions than that of agricultural primacy, a good example being "Agricultural Origins: Centers and Noncenters" by Jack R. Harlan (Science 174: 468-473, Oct. 29, 1971). This study was concerned with the question as to whether agriculture was originally discovered in small areas, called "centers," from which knowledge was gradually spread throughout the inhabited world, or whether discovery was more diffuse, occurring independently in many scattered areas. Harlan's conclusion was that there were three independent "centers" in temperate zones—(1) the Middle East, (2) North China, and (3) Central America—but that each of these seems to have been associated with a much larger and tropical "noncenter" to the south—(1) equatorial Africa, (2) Indo-China and Indonesia, and (3) large areas of South America. Geographical origins of cultivated plants were the basis for this study.

Thus, in considering the two conflicting theories, we must weigh one plausible but unsupported story against another. Mrs. Jacobs' notion that extensive trade routes existed before agriculture had been developed may take some getting used to. However, she is fairly convincing on this score, and if it is accepted the rest of her thesis follows quite logically—as a *possibility*. But there is a rule of thumb applied in the physical sciences, namely, that the simpler of two equally plausible theories should be accepted until it is proven wrong. And the orthodox theory as to agricultural origins is certainly simpler as well as older than Mrs. Jacobs' explanation.

There is also a more important reason for agricultural economists to look askance at the new theory. Most contemporary agricultural economics that is truly relevant is concerned, in one way or another, with the improvement of the lot of farmers in relation to their city cousins. The relative disadvantages of agriculture have been evident for many centuries, and it has been comforting, to some of us at least, to be able to look back on a time, 10,000 years ago, when agriculture was the "wave of the future"—when it had all the built-in income incentives now associated with nonagricultural occupations. Mrs. Jacobs would have it that agriculture has *always* been subordinate and subservient to cities, an idea which, if accepted, would be most subversive of our professional self-esteem.

Ernest W. Grove

Migrant: Agricultural Workers in America's Northeast

By William H. Friedland and Dorothy Nelkin. Holt, Rinehart and Winston, 383 Madison Ave., New York 10017. 281 pages. 1971. $2.25 (paperback).

Migratory wageworkers have always represented a significant part of the larger problem of rural poverty. Yet, compared with other disadvantaged groups, relatively few in-depth studies have been made of a class of people so plagued by a life style of deprivation. This has always been a difficult group to study. Many of the more traditional data collection techniques, such as the sample survey, are logistically difficult to handle when applied to a continuously changing population which is culturally isolated and educationally deprived. The method described by the authors is a refreshing departure from some of these more conventional techniques.

The authors, who are sociologists experienced in community studies, have applied their skills to this problem and as a result have produced a set of salient themes about the behavior of migrant laborers that are both profound and practical. The method of participant-observation was employed as the basic data collection technique. Observers kept field diaries which

they later transcribed on tape. Data were obtained during the summers of 1966-68 by students of Cornell University and Tuskegee Institute who lived individually in labor camps and worked in the field with a crew. As a result, much firsthand insight about the subtle ways in which people adjust their individual life styles to a generally stressful and coercive system was obtained.

Some researchers who are in the habit of confining themselves to a rather rigid way of approaching problem solutions will not like this book. Also, if the reader is interested in a statistically based study or in a mathematical model of migrant labor problems, he will not find it in this work. I like the book because it is rich in anecdotal impressions which are honest descriptions, factual and intellectually defensible. While the study makes no direct assertions concerning causes, the overall accumulation of evidence presented from different perspectives and points of view logically suggests that there is a syndrome of factors which act to reinforce and maintain the migrant labor problem as a social system.

The book is organized into 11 chapters, each with a summary discussion. Topics covered include environmental conditions of camp life, work relations with crew leaders, interpersonal relations, transactions with people in the outside world, and the behavior and treatment of children. An appendix discusses outsiders in the system, which includes a network of Government and private agencies which have been established to meet migrant workers' needs.

Some aspects of the study raise legitimate questions concerning the validity and reliability of the information obtained. Participant-observation studies, wherever they are carried out, always raise problems of perceptual bias, control, and "objectivity." The present investigation is no exception. In the present study, certain methodological field procedures were followed to minimize many problems of perceptual bias. However, 12 out of the total of 16 observers were whites engaged in the study of an exclusively black segment of the migrant population. From a strictly methodological point of view, we can never be sure as to the contamination effect of this racial difference, despite the fact that the observers were outwardly accepted by their work groups. However, such data collection problems are minimal when judged against the rich background of information obtained. I highly recommend this book for all people concerned with the problems of this chronically disadvantaged element of rural America.

John L. McCoy

The Nation's Environment: Problems and Action

By Environmental Quality Forum, Research Advisory Council. East Tennessee State University, Johnson City, Tenn. 37601. 99 pages. 1971. $2.50.

Mankind is in the unique historical position of being the object of three crucial threats: The nuclear bomb, the population bomb, and the environmental bomb. This book is a collection of useful writings which highlight the problems associated with our environment and which stress the need for action to offset an impending crisis.

The papers were delivered at the Environmental Forum conducted in April 1970 on the campus of East Tennessee State University, and are concerned with a wide range of environmental issues.

It is fundamental that, before any concerted effort can be made by society to resolve a universal problem, the public must recognize the severity of the problem. Although everyone is conscious that the quality of our environment has been declining over the years, there are very few persons today who are knowledgeable as to the seriousness of the problem. As an example, one shocking fact which is not generally known is, as stated by John J. Hanlon, that during approximately the last 30 years, an estimated one mammalian species each year has become extinct due to man's abuse of the earth's ecosystem.

To be sure, the sad situation of the environment is not entirely the product of man's neglect and irresponsibility; there is also the problem of insufficient knowledge about ecology. Efforts are being made by Government agencies to resolve the problems; however, the attempts have been on a problem-to-problem basis, and have often been confined to the narrowly restricted area of concern of each particular agency. Each specialized agency views a problem in its own area of responsibility, and devises narrow solutions consistent with these special interests. Frequently the approaches of one are directly contrary to those being implemented by others. The result of the divergent approaches will be a cost to our Nation of an estimated $100 billion to clean up pollution in just the next 5 years.

One must recognize that one of the biggest obstacles to improving our environment is lack of knowledge about the factors that act upon organisms and the ecological community. No one can foretell whether or not technology or development methods will have a favorable impact on our environment. This of course compounds the dilemma, and leaves no doubt that the resolution of the problems will not be easy. It will call for drastic social and economic measures, with a high price tag; nevertheless it is a price that must be paid or

there will be no survival with a quality of life that we all want.

The writings mention many important aspects of the environmental problems; however, this reviewer wishes the writers had noted more concrete resolutions to the problems.

Jack Ben-Rubin

Desalting Technology for Middle Eastern Agriculture: An Economic Case

By Jerome J. Fried and Milton C. Edlund. Praeger Publishers, 111 Fourth Ave., New York 10003. 132 pages. 1971. $12.50.

The possibility of desalination—particularly in Egypt—is the subject of this book. The first of eight chapters deals with the problems and prospects of desalination as a technology. The second and third chapters investigate the present technological possibilities for desalting water; the energy and capital costs involved; and the advantages and disadvantages of the fossil (conventional fuel) system compared with the nuclear powered system. In the next three chapters, which address the Egyptian situation, the authors discuss why they believe Egypt presents a good opportunity for undertaking desalination. The last two chapters deal with the implications of the Middle East for other nations and present some conclusions.

A brief but careful review of the Egyptian economic situation dating back to the early 1950's is given. Included are charts and analyses of production growth. Estimates to justify the building of desalination plants in terms of water use and energy output potential are presented.

The authors make a point of calculating the greatest cost with the least returns to note precisely the real possibilities of desalination in Egypt. Estimates show results that could occur under different circumstances. Margins of probability are estimated to prevent too many miscalculations and thereby too many surprises.

Egypt, say the authors, is ripe for desalination. They propose a massive program which would cost between $700 and $900 million over a 10-year period. They propose four plants, each one independent. This means that the program need not be fully implemented but could be put into operation following construction of one to four plants.

The choice of Egypt seems a good one. Yet, as the authors state, certain circumstances must be met before such an undertaking can proceed. For example, an increased rate of savings is needed. Although the government has not been able to achieve this, the authors claim it can be done with a little greater effort. Second, they point out that the agricultural situation beyond the late 1970's is somewhat uncertain, especially for the time after the full potential of the Aswan Dam is reached.

Throughout, the authors express an optimistic attitude about the Egyptian and the Middle East situation. They recognize that Egypt continues to suffer large trade deficits and state that these can be expected at least until 1985. Yet, they say, "these deficits will be financed by foreign exchange earnings from services to foreigners, largely tourism, and transit of the Suez Canal, as well as by foreign capital inflows." Of these items, one certainly earns no revenue; the Suez Canal is still not operating and probably will not for quite a while. Even if it were opened, many of the new oil-carrying supertankers would not be able to cross it. In addition, the new oil pipeline in Israel, as well as the one under construction in Egypt, will decrease further the importance and potential revenue from the canal.

In addition to the poor foreign exchange position and deficit trade situation, Egypt faces a high rate of population increase compared with a low rate of agricultural growth. USDA indexes show Egyptian agricultural growth at only 2.4 percent for the decade of the 1960's and per capita agricultural growth at only 0.2 percent—not up to standard, and not encouraging for the future gains wanted by the authors.

The authors, it should be said, do not try to "sell" their proposal. Rather, they present a case study of possibilities—of an idea, a challenge, a hope. But it seems to this reviewer that for now, there are too many "ifs" and "buts" in the way of desalting programs in Egypt. The undertaking, as proposed, depends too much on events which need to take place before or during various implementation stages. Too many aspects of too many things need to fall into line, or come up to standard, or reach a certain rate; should they not, success of this project would be questionable.

Desalination may be the wave of the future. Certainly, it is advancing from day to day. As the authors point out, desalting water has applicability in other countries in the Middle East (Israel, Saudi Arabia, and other Arab countries) where agriculture is at the mercy of the weather. Israel is using desalinated water in its southernmost city, Eilat, but not for agricultural purposes. The book ends with two appendixes, one giving greater detail on costs of desalination and the other addressing performance and rates of return of various possible technologies.

There is little doubt that desalination for Egypt deserves close scrutiny. The possible benefits of a successful undertaking would be a badly needed addition to the food and fiber of Egypt, with 250,000 acres of irrigated land brought under cultivation in the northern part of the country. This undertaking would provide a new source for rural employment, add to the country's infrastructure, provide a base for industrial expansion, strengthen rural markets, and increase what is now an extremely limited arable land area in an agriculturally deficient country. Large areas could be farmed productively all year round with a continuous supply of water.

In view of the potential benefits, the authors have good reason to state that "it is essential to look beyond currently restricted horizons. Whether crisis is endemic to the Middle East may depend, in part, on the possibilities of working out constructive and cooperative approaches to the region's long-term development problems."

Careful consideration of this study would be a good beginning toward that goal.

Michael E. Kurtzig

Brazilian Agricultural Technology and Trade: A Study of Five Commodities

By Peter T. Knight. Praeger Publishers, 111 Fourth Avenue, New York 10003. 223 pages. 1971. $15.

As background to this book, it is important to note that Brazil has made great strides in its economic development during the last few years. Since 1968, the annual rate of GNP growth has not fallen below 9 percent. Growth of the agricultural sector has been more modest. Brazil's rapid growth has been spurred in part by the growth of exports other than coffee. While the dollar value of total exports more than doubled between 1960 and 1970, coffee's share of the total dropped from 56 percent to 36 percent.

Since the early 1960's, coffee's share of Brazil's agricultural production declined while the shares of livestock products, wheat, soybeans, and corn increased. Between 1965 and 1971, production of beef increased by 22 percent; corn by 11 percent; soybeans increased five times, from 523,000 to 2.1 million metric tons; and wheat production grew from 250,000 to 2 million tons. Brazil is now the world's second largest producer of corn, third producer of soybeans, and fifth producer of meat. Between 1965 and 1971, Brazil's beef and corn exports doubled, and soybean and soybean product exports increased sixfold to 1.2 million tons (soybean equivalent), making Brazil the world's number 2 exporter of soybeans and products. Domestic production has substituted for imports of wheat—Brazil's major agricultural import. Wheat imports declined from a peak of 2.6 million tons in 1968 to 1.7 million tons in 1971.

Peter Knight's timely book makes a valuable contribution to our knowledge of Brazil's agricultural development and trade. He examines various production and trade problems relating to beef, rice, corn, soybeans. and wheat in Rio Grande do Sul—Brazil's southernmost state. Most of Brazil's exports of beef, rice, and soybeans originate in this state, which also produces 85 percent of Brazil's wheat and is an important producer of corn. The author attempts to answer many diverse questions, such as: What was the response of exporters to price incentives and export controls? What is the cost of Brazil's wheat expansion program? Why has productivity (yields and herd output) remained stagnant? What are the economic prospects for increasing productivity through the application of modern technology? The book is based on research done in 1968.

Because of the diverse nature of the many problems tackled, the book tends to be a little disjointed, both from chapter to chapter and within chapters. Chapters 1 and 2 are introductory. The first reviews Brazilian postwar economic problems as analyzed by others—problems of trade, balance of payments, economic growth, and the regional and sectorial disparity of Brazil's growth; and the second consists of background information on Rio Grande do Sul's agriculture. The four chapters forming the main body of the book cover, respectively, factors affecting exports, wheat production, productivity and technological change, and fertilizer use.

In the chapter on exports, exporters of beef, rice, and corn were found to have reacted strongly to price incentives (domestic/international price ratios) and to export controls. Soybean exports were dominated by the strong upward trend. The overvalued exchange rates which prevailed before 1968 had the effect of taxing exports, and public entities responsible for maintaining the domestic food supply had (and still retain) the power to place heavy restrictions on the export of certain commodities.

The chapter on wheat production examines the history of wheat production in Brazil, subsidies to producers and consumers, the cost of production in terms of domestic resources, reasons for the high cost of wheat, and arguments favoring domestic wheat production. Of major interest is the section calculating

the cost in domestic resources for producing wheat, beef, rice, soybeans, and corn in Rio Grande do Sul in 1967. Although the data used are somewhat weak, and price changes in the last year or two would be more favorable to wheat production, the calculations do show that Brazilian domestic production of wheat is a costly venture. It was estimated that domestic production of beef, rice, soybeans, and corn diverted between 82 and 87 cents' worth of domestic resources for every $1 of commodity produced, but that $2.20 of domestic resources were diverted for the production of $1 of wheat. Although the evidence on production costs indicates much inefficiency, the arguments favoring Brazilian wheat production are dismissed too rapidly. Not enough consideration is given to the potential for reducing future production costs, or to the marginal character of many of the resources used in wheat production, particularly the land (previously in extensive pasture).

In Brazil, agricultural production has been increased by bringing into production previously unexploited land. Little progress has been made in increasing yields since the late 1940's. Now that the agricultural frontier in southern Brazil is on the verge of disappearing, progress will have to be made in improving yields if agricultural growth is to continue. The chapter on productivity and technical change suggests that up to now most farmers in Rio Grande do Sul lacked sufficient knowledge and medium-term credit to realize the full potential of existing varieties of wheat, corn, and soybeans by the use of fertilizer and lime. Mechanization, however, has been very rapid.

In the chapter analyzing fertilizer use, it was estimated that wheat and rice were being fertilized closer to economically optimal levels in recent years than previously. No significant response to fertilizer nutrient-crop price ratios was found.

In summary, the book is recommended for those interested in the development of agriculture in Brazil. By concentrating on only five commodities and only one state, Knight was able to cover a wider range of topics and arrive at some more definitive conclusions than would have been possible had he tried tackling the problems he studies on a sectorwide or nationwide basis.

Edmond Missiaen

Change and Uncertainty in a Peasant Economy: The Maya Corn Farmers of Zinacantan

By Frank Cancian. Stanford University Press, Stanford 94305. 208 pages. 1972. $7.95.

The firm and its response to changing business opportunities are analyzed in this book. The firm in this case is the migrant Mexican peasant who descends into the nearby tropical forests to rent land for the slash-and-burn production of corn. The changing opportunities result from construction of penetration roads and the establishment of government buying stations in the area.

Probably every economist recognizes the necessity, every now and again, of turning from his concepts and analytical techniques to look at the real world. But, is the real world best seen through an overview, a gaze out the window, or a detailed view through a microscope? Probably some combination of these is necessary. In this day, when "experts" on any country can be found in any conversation, it may be well for some of us to put our knowledge and analysis to the microscope test. Frank Cancian's book is well adapted to do this for several reasons.

Cancian shows us economics through the eyes of an anthropologist. His portrayal of the "economic man" of a peasant culture reveals the great mass of built-in assumptions we take with us when we apply our techniques of economic analysis to developing countries. The detail of this study shows that agricultural data problems in developing countries are due not only to institutional weaknesses or lack of trained personnel; they also result from a failure to correlate basic assumptions with analytical techniques. For instance, the apparent standardization of quantitative measures in developed countries is the result of an agreed set of assumptions that make allowance for moisture content of a grain, foreign matter, variety, weight per bushel, etc. From these we make production estimates in bushels that have no known relationship to any given standards, but which generally meet the statistical needs of a modern marketing system.

The accepted assumptions in a peasant economy, on the other hand, may be no more difficult for the peasant, but much less adaptable to standardization in the commercial sense. In Zinacantan, both the "almud" for measuring grain yields and the "tablon" for measuring area seeded vary in size. The "almud" is larger where the land is more productive; the "tablon" becomes somewhat larger where the land is less productive. Cancian cites an interesting example of an attempt to impose fixed standards—in a complaint about short measure, a government official consistently measured out 4.5 liters of corn, whereas the vendor was repeatedly able to demonstrate that there were actually 5 liters in the exchange. A random test showed a shortage of 13.5 percent in the measure given by commercial vendors while farmers who retailed their own production gave an overage of 3.5 percent.

Cancian's economic analysis is as fascinating in its development as his description of the anthropological details of peasant agriculture. He finds the innovative response of peasants to be clearly consistent with a general theory of stratification and risk taking—a conclusion that cannot help but have serious implications for all attempts to motivate peasant sectors of developing economies. The book is useful, not only for its careful description and documentation, but for its analysis and conclusions.

Howard A. Osborn

Foundations of an Agricultural Policy in Paraguay

By Adlai F. Arnold. Praeger Publishers, 111 Fourth Ave., New York 10003. 312 pages. 1971. $17.50.

Inherent in the comprehensive analysis of a problem—in this case the problem of how to promote agricultural development—is the risk of recognizing the complexity of the problem and doing nothing. While this is not the approach to agricultural development that Arnold recommends, it characterizes past policies in Paraguay, at least in terms of policy output—the extent to which change has occurred.

Arnold suggests a pragmatic approach of first sorting out the question of the land tenure system and then hammering away at the agricultural infrastructure. He believes that the present land tenure system in Paraguay, whereby most farmers have only enough land for subsistence farming, is the principal roadblock to development. His approach makes sense in the context of Paraguayan agriculture, and it might, in fact, prove to be the best approach.

It is not the lack of an approach, however, that has stymied agricultural development in Paraguay. The problem of development has been analyzed, the potential of the land and of the human resources has been measured, plans have been made and approaches suggested. But apparently effective demand for change has not been forthcoming because, if it exists, it is not manifest in a force that is politically powerful enough to prevail. Arnold points out, and perhaps unwittingly focuses on the sine qua non, that "until the persons most affected (the small farmers themselves) become a stronger political influence in the country, the situation is likely to continue as it has for several centuries."

Bruce L. Greenshields

Banking in Frontier Iowa, 1836-1865

By Erling A. Erickson. Iowa State University Press, Ames 50010. 183 pages. 1971. $7.50.

The "Black Hawk Purchase" was a strip of land, west of the Mississippi River, which, after a bloody contest, was ceded by the Indians to the Federal Government in 1832. It was first attached to the Michigan Territory, then to the Wisconsin Territory when Michigan became a State. It became the Iowa Territory in 1838.

In 1833, the Black Hawk Purchase was opened for settlement. The author describes the movement of population into the area, the measures adopted by settlers to protect their claims to land on which they settled before the land had been surveyed and offered for sale, and measures of preserving order and punishing crime before civil government was established. He reviews the motley assortment of coins and paper money in circulation at the time and the problems they created for the settlers.

The first Iowa bank was chartered in 1837—the Miners' Bank of Dubuque. It had a checkered career and was investigated several times. Its charter was repealed in 1845.

Population expanded rapidly in (and beyond) the Black Hawk Purchase, and in 1842 the Sauk and Fox tribes ceded the remainder of their lands west of the Mississippi River to the Federal Government. Soon came efforts to secure statehood. One of the knottiest problems was to write an acceptable constitutional provision on banking. The author describes the alignment of forces and the political maneuvers that led to a constitutional prohibition of banks of issue when Iowa became a State in 1846.

As a result, Iowa continued to be a dumping ground for the notes of banks in other States; and local counties, cities, towns, and even business concerns issued scrip, warrants, and notes that circulated as money. Also, deposit banking, and the use of checks and time certificates, developed to provide services that banks of issue were forbidden to provide. The manner in which these developments occurred, and the chaotic conditions that often resulted, are interestingly described.

The author goes on to point out that, despite monetary difficulties, Iowa developed rapidly in the decade following its admission to the Union. Its economy became increasingly market oriented as the railroads spread westward and as the use of farm machinery and equipment increased. These changes made ever more necessary a monetary and banking system that would facilitate interregional exchanges of goods and funds. It was not until 1857, however, that

the constitutional prohibition against banks of issue was removed.

In 1858, legislative provision was made for the chartering of banks under a "free bank" law and for establishment of a State bank. For various reasons no bank ever was chartered under the free bank law, but the State Bank of Iowa, with eight initial branches, was established in 1858, and seven more branches were formed later. This bank also had a short career. In 1865, when the Federal Government taxed State bank notes out of existence, all but one of the branches became national banks.

Within the limits of its resources, the State Bank of Iowa apparently provided a sound currency and a credit service that met the short-term credit needs of business concerns. However, it never succeeded in driving out of circulation the notes issued by banks in other States, and it provided little, if any, of the longer term credit needed by farmers and others. Those needs, according to the author, were increasingly served by private banks of deposit which, by 1861, numbered 73 and operated in 43 Iowa communities.

Frontier economic and monetary conditions have been described in other books, and the Iowa experience was not unique. The book has special interest for persons like the reviewer, whose grandparents settled in Iowa in the 1850's. The facts in the book appear to have been carefully researched, and scalograms have been used to identify the pro- and anti-bank groups. One of the stronger features of the book is its analyses of the political influences that focused on the banking issue in Iowa.

Fred L. Garlock

Professional Forestry in the United States

By Henry Clepper. The Johns Hopkins Press, Baltimore 21218. 337 pages. 1971. $10.

The influence of a strong professional outlook on the development of national programs and policies is well illustrated in this volume on forestry. Although forest economics is recognized by both economists and foresters, there is no reference to it in the index.

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